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2004 CTS AMENDMENTS
to the
Electro-Technologies
Guide to Standards and Implementation

Summary of Curriculum Changes

New Courses:
- ELT2310: Network Structures
- ELT2320: Network Media & Devices
- ELT2330: OSI Model (Open System Interconnection)
- ELT2340: Network Protocols
- ELT2350: Local Area Networks
- ELT3310: Network Operating Systems
- ELT3320: Routing Fundamentals
- ELT3330: Wide Area Networks
- ELT3340: Internet Processes
- ELT3350: Network Management

Section B

1. **Remove** pages B.3–B.4 (1997) and pages B.5–B.8 (Revised 2000) and **replace** with new pages B.3–B.10 (Revised 2004).

Section E

1. **Remove** pages E.1–E.2 (1997) and **replace** with new pages E.1–E.2 (Revised 2004).
2. **Add** new pages E.67–E.98 (2004).

Section F

1. **Remove** pages F.1–F.2 (1997) and **replace** with new pages F.1–F.2 (Revised 2004).
2. **Add** new pages F.73–F.102 (2004).

Section G

1. **Remove** pages G.3–G.4 (1997) and **replace** with new pages G.3–G.4 (Revised 2004).
2. **Remove** page G.22 (1997) and **replace** with new page G.22 (Revised 2004).
3. **Add** new pages G.47–G.56 (2004).

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STRAND ORGANIZATION

DEVELOPMENTAL MODEL

The model depicts emphasis within the Electro-Technologies strand. The front face of the cube lists the themes and concepts that are integrated throughout the program. The right side indicates the learning contexts that will enable the student to meet the demands of daily living. The top of the cube depicts the anticipated outcomes which take the form of basic and career-specific knowledge, skills and attitudes that have been constructed by the learner.

THEMES

The courses in Electro-Technologies are grouped according to the following themes:

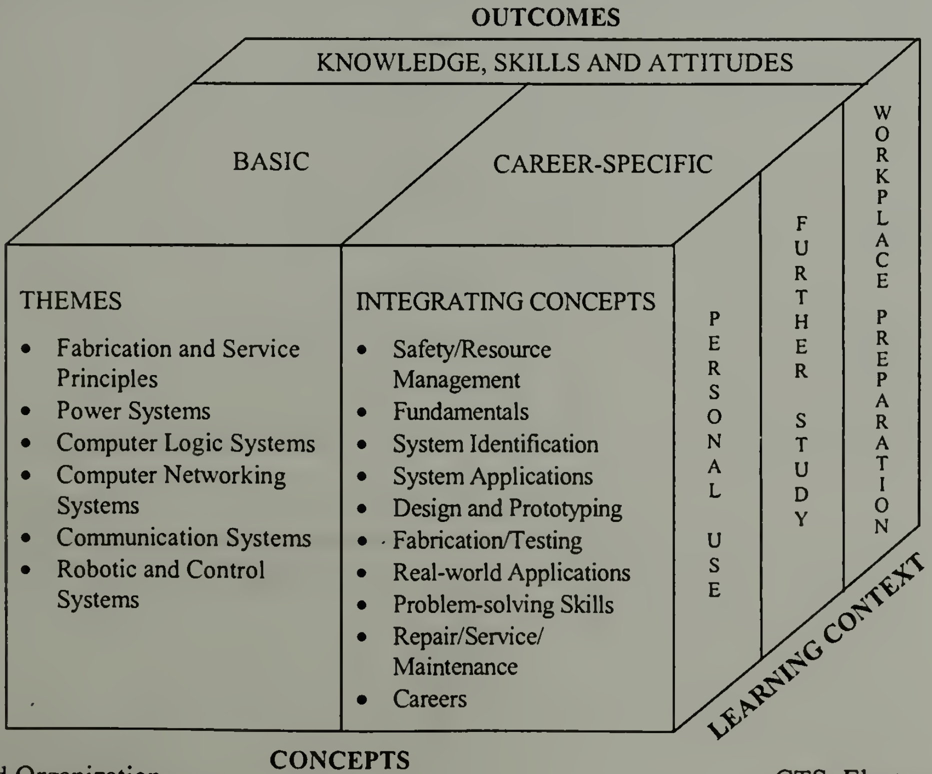
- Fabrication and Service Principles
- Power Systems
- Computer Logic Systems
- Computer Networking Systems
- Communication Systems
- Robotic and Control Systems.

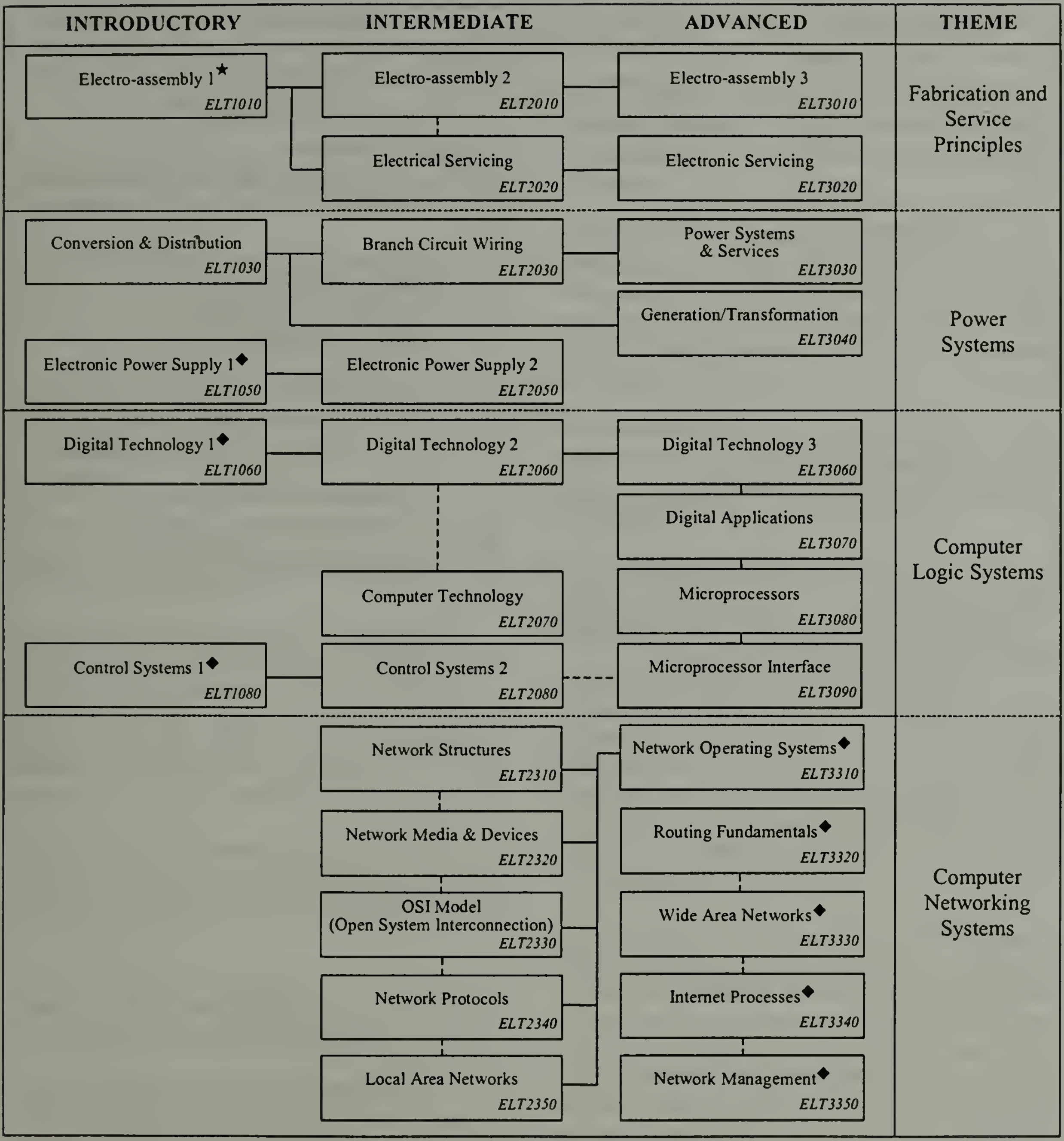
LEVELS

The Electro-Technologies courses are organized into three levels of learning: introductory, intermediate and advanced. The introductory level provides students with the basic knowledge, skills and attitudes necessary for personal use. The intermediate level focuses on the transferable knowledge, skills and attitudes that apply to many sectors of the industry. At the advanced level, students learn more career-specific knowledge, skills and attitudes that prepare them for a career in electrical/electronics industry or for further education or training.

CONCEPTS

Certain concepts are reinforced throughout the Electro-Technologies strand. These include safety and resource management, electrical/electronic fundamentals, real-world applications, fabrication and testing procedures, and problem solving. Emphasis will vary depending on course content, context and level.





INTRODUCTORY	INTERMEDIATE	ADVANCED	THEME
Electro-assembly 1★ ELT1010	Electro-assembly 2 ELT2010	Electro-assembly 3 ELT3010	Fabrication and Service Principles
	Electrical Servicing ELT2020	Electronic Servicing ELT3020	
Conversion & Distribution ELT1030	Branch Circuit Wiring ELT2030	Power Systems & Services ELT3030	Power Systems
		Generation/Transformation ELT3040	
Electronic Power Supply 1◆ ELT1050	Electronic Power Supply 2 ELT2050		
Digital Technology 1◆ ELT1060	Digital Technology 2 ELT2060	Digital Technology 3 ELT3060	Computer Logic Systems
		Digital Applications ELT3070	
	Computer Technology ELT2070	Microprocessors ELT3080	
Control Systems 1◆ ELT1080	Control Systems 2 ELT2080	Microprocessor Interface ELT3090	
	Network Structures ELT2310	Network Operating Systems◆ ELT3310	Computer Networking Systems
	Network Media & Devices ELT2320	Routing Fundamentals◆ ELT3320	
	OSI Model (Open System Interconnection) ELT2330	Wide Area Networks◆ ELT3330	
	Network Protocols ELT2340	Internet Processes◆ ELT3340	
	Local Area Networks ELT2350	Network Management◆ ELT3350	

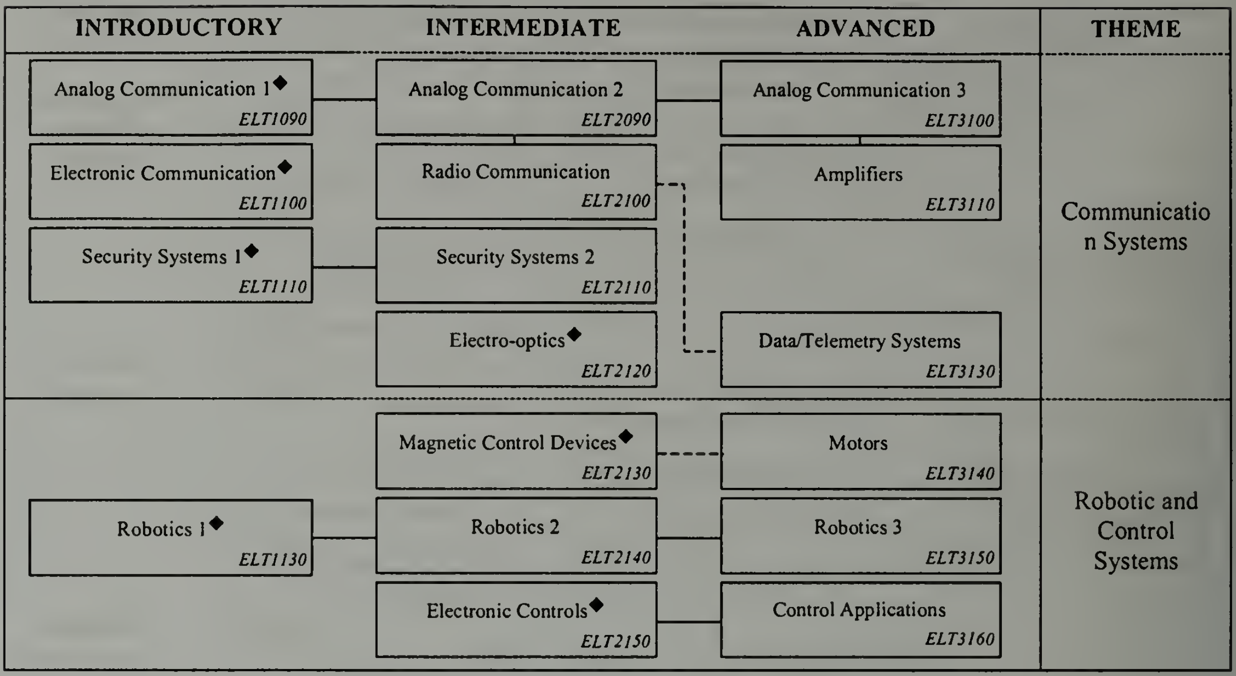
(continued)

—— Prerequisite ----- Recommended sequence

★ Course provides a strong foundation for further learning in this strand.

◆ Refer to specific courses for additional prerequisites.

SCOPE AND SEQUENCE (continued)



INTRODUCTORY	INTERMEDIATE	ADVANCED	THEME
Analog Communication 1◆ *ELT1090*	Analog Communication 2 *ELT2090*	Analog Communication 3 *ELT3100*	Communication Systems
Electronic Communication◆ *ELT1100*	Radio Communication *ELT2100*	Amplifiers *ELT3110*	
Security Systems 1◆ *ELT1110*	Security Systems 2 *ELT2110*		
	Electro-optics◆ *ELT2120*	Data/Telemetry Systems *ELT3130*	
	Magnetic Control Devices◆ *ELT2130*	Motors *ELT3140*	Robotic and Control Systems
Robotics 1◆ *ELT1130*	Robotics 2 *ELT2140*	Robotics 3 *ELT3150*	
	Electronic Controls◆ *ELT2150*	Control Applications *ELT3160*	

——— Prerequisite　　　- - - - - Recommended sequence

★Course provides a strong foundation for further learning in this strand.
◆Refer to specific courses for additional prerequisites.

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COURSE DESCRIPTIONS

Course ELT1010: Electro-assembly 1
Students apply basic fabricating and servicing techniques to construct and test electronic and electromagnetic devices and cables.

Course ELT1030: Conversion & Distribution
Students experiment and work with principles of electrical energy conversion and distribution.

Course ELT1050: Electronic Power Supply 1
Students construct different types of alternating and direct current power supplies, and demonstrate their application in electrical/electronic systems.

Course ELT1060: Digital Technology 1
Students construct and demonstrate logic systems and their unique functions.

Course ELT1080: Control Systems 1
Students construct process control systems, demonstrate their basic operation, and demonstrate procedures for testing them.

Course ELT1090: Analog Communication 1
Students install and demonstrate the fundamentals of various consumer audio integrated systems.

Course ELT1100: Electronic Communication
Students demonstrate the fundamentals of video systems, and describe their uses.

Course ELT1110: Security Systems 1
Students install and demonstrate the fundamentals of sensors, control units and warning devices used in security systems.

Course ELT1130: Robotics 1
Students apply the fundamentals of robotic systems and basic robotic functions.

Course ELT2010: Electro-assembly 2
Students apply electro-assembly technology to manufacture circuit boards.

Course ELT2020: Electrical Servicing
Students demonstrate the fundamental concepts of repairing, servicing and maintaining electrical and electronic equipment.

Course ELT2030: Branch Circuit Wiring
Students demonstrate the fundamentals of branch circuit wiring used in residential/commercial buildings.

Course ELT2050: Electronic Power Supply 2
Students construct and demonstrate the fundamentals of electronic power supply technology.

Course ELT2060: Digital Technology 2
Students demonstrate knowledge of digital principles, by using small-scale transistor–transistor logic (TTL) and complementary metal oxide semiconductor (CMOS) integrated technology.

Course ELT2070: Computer Technology
Students develop the knowledge and skills required to install and configure a disc operating system and to set up a computer network.

Course ELT2080: Control Systems 2
Students demonstrate how process control technology is used in real-world applications.

Course ELT2310: Network Structures
Students acquire an understanding of network infrastructure and assess the advantages and disadvantages of different types of networks. They also develop knowledge of data transmission principles in a computer network and compare features of different network topologies and transmission methods.

Course ELT2320: Network Media & Devices
Students develop an understanding of different connectivity strategies for linking computers and other devices in a local area network (LAN). They acquire knowledge of industry standards for network cables and gain practical experience through installing cabling, connectors and other hardware components.

Course ELT2330: OSI Model (Open System Interconnection)
Students develop knowledge of the Open System Interconnection (OSI) reference model and its use as a conceptual framework for analyzing network communication tasks. They examine OSI reference model characteristics, the functions of each of its seven layers, and how data moves between layers of the reference model when computers establish a network connection.

Course ELT2340: Network Protocols
Students acquire basic knowledge of upper-layer protocol suites that permit the networking of computers. They examine reasons for the extensive use of the Transmission Control Protocol/Internet Protocol (TCP/IP) in computer networks, and develop knowledge and skills relevant to installing, configuring and maintaining a TCP/IP client on a network.

Course ELT2350: Local Area Networks
Students extend their understanding of technologies used in a local area network (LAN) and examine specifications for an Ethernet LAN. They develop knowledge of a general strategy for network design and apply the strategy to design, implement and troubleshoot a small LAN.

Course ELT2090: Analog Communication 2
Students demonstrate the fundamental concepts of electronic analog communication systems.

Course ELT2100: Radio Communication
Students demonstrate the fundamental concepts of electromagnetic communication systems.

Course ELT2110: Security Systems 2
Students demonstrate the fundamentals of security technology used in homes, businesses and transportation systems.

Course ELT2120: Electro-optics
Students demonstrate basic knowledge of lasers and other light wave communication applications in various electronic systems.

Course ELT2130: Magnetic Control Devices
Students demonstrate the fundamentals of electromagnetic control devices.

Course ELT2140: Robotics 2
Students demonstrate the fundamental concepts of sensor devices and control systems, by building an electronic circuit to control a direct wire or mobile robot.

Course ELT2150: Electronic Controls
Students demonstrate the fundamentals of ladder/relay logic programming, and demonstrate how the program's logic controller system operates.

Course ELT3010: Electro-assembly 3
Students apply photographic processes to construct a printed circuit for an electronic project.

Course ELT3020: Electronic Servicing
Students develop and apply basic processes and skills to service and repair consumer-based electronic products.

Course ELT3030: Power Systems & Services
Students construct, operate, analyze and evaluate various single-phase and three-phase power systems and services.

Course ELT3040: Generation/Transformation
Students operate, experiment with and analyze alternators and transformers used in power generation and distribution.

Course ELT3060: Digital Technology 3
Students demonstrate knowledge of digital principles by using medium-scale transistor–transistor logic (TTL) and complementary metal oxide semiconductor (CMOS) integrated technology.

Course ELT3070: Digital Applications
Students experiment with large-scale and very large-scale integrated circuits, and demonstrate their applications to practical situations.

Course ELT3080: Microprocessors
Students compare the internal architecture of microprocessors and program them, using instruction sets.

Course ELT3090: Microprocessor Interface
Students demonstrate how to interface microprocessors/microcontrollers with real-world applications.

Course ELT3310: Network Operating Systems
Students examine the features, advantages and disadvantages of major network operating systems, and the criteria involved in selecting network operating systems that are appropriate in specific networking environments. They develop knowledge and skills required to install and configure different network and client operating systems, and develop a strategy for troubleshooting problems resulting from the installation of operating system software.

Course ELT3320: Routing Fundamentals
Students extend their knowledge of wide area networks (WANs) by examining the process by which information is routed through an internetwork. They examine the major functions and components of a router, develop knowledge of common routing protocols, and gain practical experience in basic router configuration.

Course ELT3330: Wide Area Networks
Students develop basic knowledge of the technologies employed in a wide area network (WAN) and of how a WAN may be used to connect local area networks (LANs) at different locations. They gain practical experience in using WAN technologies to establish remote network access, and they analyze emerging WAN technologies with respect to impact on global networking.

Course ELT3340: Internet Processes
Students apply their knowledge of wide area network (WAN) technologies to an Internet environment. Course content focuses on the significance and utility of Internet Protocol (IP) addressing schemes in Internet communication and on the function of WAN protocols and services in providing Internet access. Students develop knowledge of internetworking career paths and related educational opportunities.

Course ELT3350: Network Management
Students acquire knowledge of internal and external risks to a network and develop strategies for protecting network data and securing a network. They also develop and apply a general strategy for troubleshooting network problems and acquire knowledge of the basic roles and responsibilities associated with network maintenance and support.

Course ELT3100: Analog Communication 3
Students demonstrate the principal concepts of electronic analog communication systems.

Course ELT3110: Amplifiers
Students demonstrate knowledge of various types and classes of amplifiers.

Course ELT3130: Data/Telemetry Systems
Students demonstrate the fundamentals of various data/telemetry systems, and demonstrate their applications to the real world.

Course ELT3140: Motors
Students demonstrate knowledge of electric motor operation and loading characteristics.

Course ELT3150: Robotics 3
Students demonstrate remote/autonomous control systems, by constructing circuits to control robotic behaviour.

Course ELT3160: Control Applications
Students demonstrate the fundamentals of programmed controls, and demonstrate how sensing devices are integrated to control output devices.

COURSE CURRICULUM AND ASSESSMENT STANDARDS: SECTION E: INTERMEDIATE LEVEL

The following pages define the curriculum and assessment standards for the intermediate level of Electro-Technologies.

Intermediate level courses help students build on the competencies developed at the introductory level and focus on developing more complex competencies. They provide a broader perspective, helping students recognize the wide range of related career opportunities available within the strand.

Course ELT2010: Electro-assembly 2 .... E.3
Course ELT2020: Electrical Servicing E.7
Course ELT2030: Branch Circuit Wiring E.11
Course ELT2050: Electronic Power Supply 2 .... E.15
Course ELT2060: Digital Technology 2 .... E.19
Course ELT2070: Computer Technology E.23
Course ELT2080: Control Systems 2 .... E.29
Course ELT2090: Analog Communication 2 .... E.35
Course ELT2100: Radio Communication E.39
Course ELT2110: Security Systems 2 .... E.45
Course ELT2120: Electro-optics E.51
Course ELT2130: Magnetic Control Devices E.55
Course ELT2140: Robotics 2 .... E.59
Course ELT2150: Electronic Controls E.63
Course ELT2310: Network Structures E.67
Course ELT2320: Network Media & Devices E.73
Course ELT2330: OSI Model (Open System Interconnection) E.79
Course ELT2340: Network Protocols E.87
Course ELT2350: Local Area Networks E.93

COURSE ELT2310: NETWORK STRUCTURES

Level: Intermediate

Theme: Computer Networking Systems

Prerequisite: None

Description: Students acquire an understanding of network infrastructure and assess the advantages and disadvantages of different types of networks. They also develop knowledge of data transmission principles in a computer network and compare features of different network topologies and transmission methods.

Parameters: Designed to be delivered in conjunction with other intermediate level courses in the Computer Networking Systems theme. Schools have the option of delivering courses within this theme in conjunction with one or more Project courses from the Career Transitions theme if they wish to extend learning and/or address other vendor-specific technologies.

Access to a computer work centre equipped with networking hardware, software, tools and consumable supplies, and to instruction from an individual with specialized knowledge and skills in computer networking.

Particular emphasis is given to network infrastructure and concepts/terminology relevant to network topology and architecture. Students model and assume personal responsibility for ethical behaviour in their use of networking technologies and in their access to electronic sources of information. They also demonstrate an understanding of industry-based policies regarding network use and security.

Supporting Courses: ELT1010: Electro-assembly 1, ELT1060: Digital Technology 1, ELT2070: Computer Technology, INF2010: Workstation Operations, INF2190: Telecommunications 1

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• describe and explain the evolution of computer networks, and the general structure and function of: – peer-to-peer and server-based networks – local area networks and wide area networks	• a teacher-directed evaluation on: – specific milestones in the history of computer networking – the structure and function of: • peer-to-peer networks and server-based networks • local area networks (LANs) and wide area networks (WANs) – the sharing of resources within a network environment	10

COURSE ELT2310: NETWORK STRUCTURES (cointinued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• describe and demonstrate basic principles of data transmission in a computer network	• a presentation or project demonstrating knowledge of: – the characteristics of analog and digital signaling and related technical terms – basic processes for structuring data packets and frames – strategies used to address data collision in a shared media environment	25
• describe and compare the features of: – bus, star, ring, mesh, wireless and hybrid topologies – Ethernet, token ring, Fibre Distributed Data Interface (FDDI) and wireless transmission methods	• a presentation or project demonstrating knowledge of: – bus, star, ring, mesh, wireless and hybrid topologies with respect to: • physical layout • unique characteristics, advantages and disadvantages – the main features of common network architectures, including Ethernet, token ring, Fibre Distributed Data Interface (FDDI) and wireless networks, with respect to: • topology • methodology and access strategy • media type • speed • selecting an appropriate topology and network architecture, given a particular set of network requirements	50
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – safety regulations specific to the networking technologies being used	5
• identify career paths in computer networking	• a project or report identifying technical and professional career paths in computer networking and related training requirements/qualifications *Assessment Tools* *Assessment Checklist: Network Structures (ELT2310–1)* *Assessment Checklist: Laboratory Procedures and Safety Practices, ELTPSP* *Standard* *Performance rating of 2 on each criterion*	10

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate basic competencies.	*Assessment of student achievement should be based on:* • observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Outcomes	Notes
History of Networks	*The student should:* • summarize the history of networking, from the telegraph to modern computer technology • describe the evolution of standards for data transmission, from Morse code to the American Standard Code for Information Interchange (ASCII) • create a timeline of specific milestones in the history of computer networking • identify emerging networking technologies and their impact on global communications.	Relate the evolution of networking devices to the evolution of computers. Milestones should include military and Internet applications. Research one or more recent initiatives or issues in the development of networking technologies.
Network Structure and Function	• describe a computer network and solutions provided by computer networking; i.e.: – file sharing – hardware sharing – program sharing – user communication • give examples of resources commonly shared within a network environment • describe the structure, purpose and function of peer-to-peer and server-based networks	Discuss and develop a rationale for networking standards. Examine advantages, disadvantages and applications of peer-to-peer and server-based networks.

Concept	Specific Outcomes	Notes
	The student should:	
Network Structure and Function (continued)	• compare and contrast peer-to-peer and server-based networks with respect to: – number of workstations – relative cost – security – administration – data backup	
	• describe and compare the structure, purpose and function of local area networks (LANs), metropolitan area networks (MANs) and wide area networks (WANs)	Discuss and give examples of: • Workgroup LANs • Departmental LANs • Enterprise networks.
	• create schematic diagrams for the physical layout of LANs, MANs and WANs	Examine the structure of the Internet within the context of LANs, MANs and WANs.
	• describe and give examples of how networks may be categorized according to: – topology – protocol – architecture – media.	
Data Transmission Principles	• describe characteristics of digital and analog signaling	
	• explain concepts and technical terms associated with data signaling and transmission; e.g.: – propagation, modulation and encoding – baseband and broadband signaling – transmission speed and bandwidth – attenuation, reflection and noise – dispersion, jitter and latency – data collision	Examine the significance of bandwidth and differences in media bandwidth. Explain throughput and variables that determine throughput.
	• describe and illustrate the structure of data packets and frames	
	• explain applications of packet sniffing software to capture and analyze data packets and frames	
	• convert binary and hexadecimal numbers to decimal numbers	Discuss where and when collisions occur, and the application of hubs, repeaters and segmentation.
	• identify problems and solutions related to data collision in a shared media environment.	

COURSE ELT2310: NETWORK STRUCTURES (cointinued)

Concept	Specific Outcomes	Notes
	The student should:	
Network Topology and Architecture	• describe and compare the unique characteristics, advantages and disadvantages of common physical network topologies; i.e.: – bus – star – ring – mesh – wireless – hybrid	Students should: • recognize a logical/ physical topology from a description or diagram • identify IEEE 802 and other standards for Ethernet, token ring and FDDI networking technologies.
	• explain the function of network segments and backbones	
	• create schematic diagrams for the physical layout of bus, star, ring, mesh, wireless and hybrid topologies	Examine reasons for the extensive use of Ethernet technology.
	• describe the architecture of an Ethernet network with respect to: – physical topology – access strategy – Carrier Sense Multiple Access with Collision Detection (CSMA/CD) – media and hardware devices – Institute of Electrical and Electronics Engineers (IEEE) standards	Compare and contrast two Ethernet frame types. Cite reasons why Attached Resource Computer network (ARCnet) has been replaced with other network architectures.
	• describe and compare the main features of token ring, Fibre Distributed Data Interface (FDDI), LocalTalk and wireless networks with respect to: – topology – methodology and access strategy – media type – speed	Conduct an interview with a network manager or client regarding network design, benefits and issues. Create a questionnaire to gather information when planning or expanding a network.
	• select an appropriate topology and network architecture, and design a network to address user needs, given a particular set of network requirements.	

COURSE ELT2310: NETWORK STRUCTURES (cointinued)

Concept	Specific Outcomes	Notes
	The student should:	
Career Paths	• research technical and professional career paths and employment opportunities in computer networking • evaluate current employment opportunities based on employment statistics • identify training requirements and qualifications associated with one or more employment opportunities • write a detailed job description for one or more internetworking positions • research trends in computer networking and emerging career opportunities.	Plan for individual/group research and presentations that address: • job description • employment market • education/training • salary range. Arrange/facilitate: • information interviews • work study/ experience • job shadowing.

COURSE ELT2320:	**NETWORK MEDIA & DEVICES**
Level:	Intermediate
Theme:	Computer Networking Systems
Prerequisite:	None
Description:	Students develop an understanding of different connectivity strategies for linking computers and other devices in a local area network (LAN). They acquire knowledge of industry standards for network cables and gain practical experience through installing cabling, connectors and other hardware components.
Parameters:	Designed to be delivered in conjunction with other intermediate level courses in the Computer Networking Systems theme. Schools have the option of delivering courses within this theme in conjunction with one or more Project courses from the Career Transitions theme if they wish to extend learning and/or address other vendor-specific technologies. Access to a computer work centre equipped with networking hardware, software, tools and consumable supplies, and to instruction from an individual with specialized knowledge and skills in computer networking. Particular emphasis is given to safe processes for the installation of network cabling and connectors and to an understanding of how topology, cabling and connectors need to coexist in a network environment. Students model and assume personal responsibility for ethical behaviour in their use of networking technologies and in their access to electronic sources of information. They also demonstrate an understanding of industry-based policies regarding network use and security.
Supporting Courses:	ELT1010: Electro-assembly 1, ELT1060: Digital Technology 1, ELT2070: Computer Technology, INF2010: Workstation Operations, INF2190: Telecommunications 1

COURSE ELT2320: NETWORK MEDIA & DEVICES (continued)

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify and describe the characteristics, standard names and applications for common network media and connectors	• a teacher-directed evaluation designed to determine knowledge of: – the characteristics and uses of major types of network cables and common media connectors – the characteristics and uses of major types of wireless network devices – cable identifiers for an Ethernet network as defined by the Institute of Electrical and Electronics Engineers (IEEE) standards – categories for networking cable as defined by the Electronics Industries Association and the Telecommunications Industries Association (EIA/TIA)	20
• identify and explain the purpose, features and basic operation of network hardware components	• a presentation or project demonstrating the functionality and performance of: – basic hardware components, including network interface card (NIC), hub, repeater, switch, bridge, router, gateway, wireless access point and modem – different types of power fault-tolerance equipment	20

• demonstrate knowledge of cabling tools; and demonstrate ability to install network cabling, connectors and hardware components	• a series of projects that demonstrate adherence to codes/regulations and safe practices for compliant installation; i.e.:
	– crimping and testing an Ethernet cable
	– safely installing
	  • jacks and outlets
	  • cable and structured cable runs
	  • patch panels and patch cords
	– utilizing basic test equipment and analyzers for continuity, proper grounding and correct cable termination
	– choosing an appropriate cable type and connector to add a new client to an existing network
	– installing and configuring one or more network components
		50

• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – safe procedures for the installation of cabling, connectors and hardware components	5

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify and describe career paths and employment opportunities in network infrastructure design and installation	• a project or report identifying technical and professional career opportunities in network infrastructure design and installation, and related training requirements/qualifications *Assessment Tools* *Assessment Checklist: Network Media & Devices (ELT2320–1)* *Assessment Checklist: Laboratory Procedures and Safety Practices, ELTPSP* *Standard* *Performance rating of 2 on each criterion*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Outcomes	Notes
	The student should:	
Network Media and Connectors	• identify and describe the structural components and uses of major types of network cables: – coaxial (thick and thin) – twisted pair (unshielded and shielded) – fibre-optic • identify and describe the characteristics and uses of common media connectors; e.g.: – Registered Jack 11 (RJ-11) – Registered Jack 45 (RJ-45) – Attachment Unit Interface (AUI) – British Naval Connector (BNC) – Small Computer System Interface (SCSI) – Single Mode Fibre-Optic Connector (SC-type and ST-type)	Match common types of cable with their attributes and applications. Students should be able to choose the best media for a specific situation. Focus attention on: • structural components • topology • advantages/ disadvantages • applications.

COURSE ELT2320: NETWORK MEDIA & DEVICES (continued)

Concept	Specific Outcomes	Notes
	The student should:	
Network Media and Connectors (continued)	• identify Institute of Electrical and Electronics Engineers (IEEE) standards for Ethernet cabling; i.e.: – bandwidth/speed – transmission mode – maximum segment length – cable type	Students should be able to identify 802.3 Ethernet standards for: • 10Base2 • 10Base5 • 10BaseF • 10BaseT • 100Base FX • 100 BaseT • 1000Basex.
	• identify and describe categories for unshielded twisted pair (UTP) cable defined by the Electronics Industries Association and the Telecommunications Industries Association (EIA/TIA) • describe the media and function of network backbones and segments • explain the relationship between media type, connector and topology in a network environment • choose an appropriate cable type and connector to add a client, given a practical network scenario.	Particular emphasis should be placed on Categories 3, 4 and 5. Discuss potential applications of Category 6 UTP cable for Gigabit Ethernet networks.
Hardware Components	• explain the purpose of hardware components in: – connecting network devices – boosting data signals – determining data flow • demonstrate an understanding of the features, functionality and performance of basic hardware components; i.e.: – network interface card (NIC) – hub – repeater – switch – bridge – router – gateway – wireless access point – modem	Hardware components are typically used to connect: • devices to networks • networks to other networks. Identify different types of NICs and NIC connectors. Compare and contrast the function of bridges, switches and routers. Investigate functionality and applications of: • Integrated Services Digital Network (ISDN) adapters • system-area network cards.

Concept	Specific Outcomes	Notes
Hardware Components (continued)	*The student should:* • identify layers of the Open System Interconnection (OSI) reference model at which specific hardware components operate	ELT2330: OSI Model provides an opportunity for more extensive study of the OSI model.
	• describe the features and functionality of power fault-tolerance hardware; i.e.: – surge suppressor – power (line) conditioner – uninterruptible power supply (UPS)	Discuss damages that may occur as a result of typical power line problems; e.g.: • surges and spikes • sags and brownouts • oscillation.
	• choose an appropriate hardware component to use or replace an existing device, given a practical network scenario	Recommend a hardware solution for a small company.
	• physically install a network interface card (NIC) and verify that the NIC is operational.	
Cabling Tools and Procedures	• demonstrate correct use of cabling tools; e.g.: – wire crimper – punch down tool	Follow wiring specifications and sequences established through EIA/TIA 568 standards.
	• demonstrate appropriate use of basic test equipment; e.g.: – media testers/certifiers – crossover cable – tone generator and probe (fox and hound) – optical testers	Demonstrate correct use of cabling tools to strip cables and attach connectors.
	• demonstrate proper sequence of steps to crimp and test Ethernet cable	Explain the concept of termination and the use of terminating resistors.
	• select the appropriate cabling tool and test equipment, given a practical cabling task.	

Concept	Specific Outcomes	Notes
Compliant Installation	*The student should:* • demonstrate procedures for compliant installation of: – jacks and outlets – cable and structured cable runs – patch panels and patch cords • demonstrate appropriate use of test equipment in checking for: – continuity – proper grounding – correct cable termination • create a proposal for a new or refit cabling project • design, build and troubleshoot a small Ethernet network.	Apply EIA/TIA standards and recommendations for structured and backbone cabling. Physical aspects of installing structured cabling include: • planning the installation • pulling and connecting cables • testing cable runs and tracing cables. Discuss strategies for integrating old and new cabling systems. Emphasize relationships among topology, cabling and connectors in a network environment.
Career Paths	• research technical and professional career opportunities in network infrastructure design and installation • place network infrastructure design and installation job titles in a progressive sequence • identify training requirements and qualifications associated with one or more employment opportunities • write a detailed job description for one or more network infrastructure design and/or installation positions.	Plan for individual/group research and presentations that address: • job description • employment market • education/training • salary range. Research available network industry certification tracks.

COURSE ELT2330: **OSI MODEL (Open System Interconnection)**

Level: Intermediate

Theme: Computer Networking Systems

Prerequisite: None

Description: Students develop knowledge of the Open System Interconnection (OSI) reference model and its use as a conceptual framework for analyzing network communication tasks. They examine OSI reference model characteristics, the functions of each of its seven layers, and how data moves between layers of the reference model when computers establish a network connection.

Parameters: Designed to be delivered in conjunction with other intermediate level courses in the Computer Networking Systems theme. Schools have the option of delivering courses within this theme in conjunction with one or more Project courses from the Career Transitions theme if they wish to extend learning and/or address other vendor-specific technologies.

Access to a computer work centre equipped with networking hardware, software, tools and consumable supplies, and to instruction from an individual with specialized knowledge and skills in computer networking.

Primary focus should be placed on the physical, data link, network and transport layers of the OSI reference model, and on the real-world protocols and networking devices that operate at each of these layers. Students model and assume personal responsibility for ethical behaviour in their use of networking technologies and in their access to electronic sources of information. They also demonstrate an understanding of industry-based policies regarding network use and security.

Supporting Courses: ELT1010: Electro-assembly 1, ELT1060: Digital Technology 1, ELT2070: Computer Technology, INF2010: Workstation Operations, INF2190: Telecommunications 1

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• describe the general purpose and structure of the OSI reference model as a conceptual framework for network communication	• a test, presentation or project designed to address the following topics: – the general purpose of the OSI reference model as a standard blueprint for designing, implementing and operating network hardware and software – the seven layers of the OSI reference model and their functions – how data moves between layers of the OSI reference model	20

COURSE ELT2330: OSI MODEL (Open System Interconnection) (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• explain and illustrate how hardware components, network protocols and encapsulation defined in lower layers of the OSI reference model move data across the network; i.e.:	• a presentation, project or examination designed to demonstrate knowledge of:	60
– physical layer	– the characteristics and design structure of components and devices associated with the physical layer – processes used to select, install and configure a network adapter	
– data link layer	– network protocols, hardware components and addressing associated with the data link layer, and ability to relate these to the logical link control (LLC) and media access control (MAC) sublayers – Institute of Electrical and Electronics Engineers (IEEE) standards for the data link layer	
– network layer	– network protocols, hardware components and addressing associated with the network layer – basic processes of path determination and routing – physical and logical addressing systems	
– transport layer	– the function of transport layer protocols in flow control, error handling and name resolution	
• explain the function of upper layers of the OSI reference model in providing client support; i.e.: – session layer – presentation layer – application layer	• a presentation or project designed to demonstrate the function of application protocols associated with the upper layers of the OSI reference model in providing client support	10

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – safety regulations specific to the networking technologies being used	5
• identify and describe information and communication technology careers within the context of the OSI reference model	• a project or report identifying technical and professional career opportunities relevant to communication tasks defined at different layers of the OSI reference model *Assessment Tools* *Assessment Checklist: OSI Model (ELT2330–1)* *Assessment Checklist: Laboratory Procedures and Safety Practices, ELTPSP* *Standard* *Performance rating of 2 on each criterion*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Outcomes	Notes
	The student should:	
OSI Reference Model	• explain the purpose of the OSI reference model as a blueprint for designing, implementing and operating network hardware and software • identify the functions of each of the seven layers of the OSI reference model • explain and diagram data transfer between layers of the OSI reference model • explain processes of data encapsulation and de-encapsulation in the OSI reference model • describe the process of data packet delivery and the function of a data frame	Each layer of the OSI reference model defines a set of functions, protocols, hardware and procedures used to move information over a network. Students should understand what each layer of the OSI reference model defines and which network elements (e.g., protocols, devices) operate at each layer.

COURSE ELT2330: OSI MODEL (Open System Interconnection) (continued)

Concept	Specific Outcomes	Notes
OSI Reference Model (continued)	*The student should:* • match network components and connectivity devices to the layers of the OSI reference model at which they operate • analyze networking tasks with respect to the OSI reference model.	
Physical Layer	• identify physical layer components and their function; i.e.: – cabling – connectors – network interface cards – repeaters – hubs • describe data signaling at the physical layer • identify Ethernet standards for media type and maximum segment length • demonstrate ability to: – select appropriate cables and connectors – select, install and configure a network adapter – terminate an Ethernet network – test for connectivity • given specific user requirements: – design physical layer topology and components for a small Ethernet network – create a plan for cabling based on Ethernet standards.	This layer is concerned with the physical nature of a network, which includes cabling, connectors, network interface cards, and the processes that convert bits into signals for sending and signals into bits when receiving. Compare and contrast 802.3 Ethernet media standards for: • 10BaseT • 100BaseFX • 1000Basex. Discuss elements of a logical diagram, and create a logical diagram for a network topology.
Data Link Layer	• identify data link layer devices and their function; i.e.: – bridges – switches • explain the effects of segmentation in switched networks • identify data link sublayers and their function: – logical link control (LLC) sublayer – media access control (MAC) sublayer • outline Institute of Electrical and Electronics Engineers (IEEE) standards for the data link layer	This layer provides context to the physical layer's bits by formatting them into packets, providing error-checking and correction services, and avoiding transmission conflicts on the network. Students should understand the role of the data link layer in packaging data for transmission by the physical layer.

COURSE ELT2330: OSI MODEL (Open System Interconnection) (continued)

Concept	Specific Outcomes	Notes
Data Link Layer (continued)	*The student should:* • describe connectionless and connection-oriented services associated with the LLC sublayer • explain the nature and limitations of physical addressing associated with the MAC sublayer • explain applications of framing in the transport of data packets • describe and illustrate the structure of a data frame • explain the function of frame addressing and frame relay in the transport of data packets.	Research the function of switching hardware with respect to: • store-and-forward and cut-through data transport • half-duplex and full-duplex network access. Convert between hexadecimal and decimal notation. Compare unicast, multicast and broadcast addressing.
Network Layer	• identify network layer devices and their function; i.e.: – router – brouter • explain the process of routing and the function of: – routing metrics – routing tables • distinguish between: – static and dynamic routing – routable and nonroutable protocols • identify common routing protocols and their function; e.g.: – Open Shortest Path First (OSPF) – Routing Information Protocol (RIP) – Novell NetWare Link-Services Protocol (NLSP) • compare physical addressing associated with the data link layer and logical addressing associated with the network layer • identify logical addressing protocols and their function; i.e.: – Internet Protocol (IP) – Internetwork Packet Exchange (IPX).	This layer addresses data for delivery and converts network addresses into physical addresses. Routing of messages on the network and internetwork also occurs at the network layer. Identify common routing metrics: • maximum transmission units (MTUs) • hop count. Compare static and dynamic routers with respect to: • configuration • routing • efficiency • security. Compare logical addressing in a network to addressing schemes used by the postal system.

COURSE ELT2330: **OSI MODEL (Open System Interconnection)** (continued)

Concept	Specific Outcomes	Notes
	The student should:	
Transport Layer	• identify and explain types of error checking performed at the transport layer: – cyclic redundancy checks – parity bits – checksum calculations • provide a rationale for flow control, and identify hardware and software solutions implemented at the transport layer • explain name resolution functions performed at the transport layer • identify common transport layer protocols and their function; e.g.: – Transmission Control Protocol (TCP) – User Datagram Protocol (UDP) – Sequenced Packet Exchange (SPX) – AppleTalk Transaction Protocol/Name Binding Protocol (ATP/NBP) – Network Basic Input Output System/NetBIOS Enhanced User Interface (NetBIOS/NetBEUI).	This layer handles the connection among network computers as they communicate and match messages to the capabilities and restrictions of the network medium. Messages are divided into smaller pieces for transmission and reassembled at their destination. The transport layer supports the delivery of messages as well as error detection and recovery. Distinguish between connection-oriented and connectionless protocols.
Session, Presentation and Application Layers	• identify modes for communication associated with the session layer: – simplex – half-duplex – full-duplex • describe data compression and encryption processes associated with the presentation layer • identify file formats that serve as standards for the presentation layer • describe network services provided by the application layer: – message handling – file transfer – database queries	These layers are primarily concerned with providing client support. The functions of upper layer application protocols include: • transfer of electronic mail • transport of files from one computer to another • monitoring network devices.

COURSE ELT2330: OSI MODEL (Open System Interconnection) (continued)

Concept	Specific Outcomes	Notes
Session, Presentation and Application Layers (continued)	*The student should:* • identify upper layer application protocols and their function; e.g.: – Simple Mail Transfer Protocol (SMTP) – File Transfer Protocol (FTP) – Simple Network Management Protocol (SNMP).	
Career Paths	• research technical and professional career opportunities relevant to communication tasks defined at different layers of the OSI reference model • place networking job titles relevant to one or more layers of the OSI reference model in a progressive sequence • identify training requirements and qualifications associated with one or more employment opportunities • write a detailed job description for a networking position, and explain how duties support communication tasks defined by the OSI reference model.	Plan for individual/group research and presentations that address: • job description • employment market • education/training • salary range. Research available network industry certification tracks.

COURSE ELT2340: NETWORK PROTOCOLS

Level: Intermediate

Theme: Computer Networking Systems

Prerequisite: None

Description: Students acquire basic knowledge of upper-layer protocol suites that permit the networking of computers. They examine reasons for the extensive use of the Transmission Control Protocol/Internet Protocol (TCP/IP) in computer networks, and develop knowledge and skills relevant to installing, configuring and maintaining a TCP/IP client on a network.

Parameters: Designed to be delivered in conjunction with other intermediate level courses in the Computer Networking Systems theme. Schools have the option of delivering courses within this theme in conjunction with one or more Project courses from the Career Transitions theme if they wish to extend learning and/or address other vendor-specific technologies.

Access to a computer work centre equipped with networking hardware, software, tools and consumable supplies, and to instruction from an individual with specialized knowledge and skills in computer networking.

Particular emphasis is placed on developing knowledge of TCP/IP and its suite of protocols. Students model and assume personal responsibility for ethical behaviour in their use of networking technologies and in their access to electronic sources of information. They also demonstrate an understanding of industry-based policies regarding network use and security.

Supporting Courses: ELT1010: Electro-assembly 1, ELT1060: Digital Technology 1, ELT2070: Computer Technology, INF2010: Workstation Operations, INF2190: Telecommunications 1

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• describe and compare standard networking protocol suites with respect to function, addressing requirements, interoperability and naming conventions	• a teacher-directed evaluation designed to determine knowledge of, and ability to differentiate among, the following networking protocol suites in terms of routing, addressing schemes, interoperability and naming conventions – Transmission Control Protocol/Internet Protocol (TCP/IP) – Internetwork Packet Exchange/Sequenced Packet Exchange (IPX/SPX) – NetBIOS Enhanced User Interface (NetBEUI) – AppleTalk	10

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify and explain reasons for the extensive use of the TCP/IP suite in computer networks, and identify and explain major protocols that operate within the TCP/IP suite	• a presentation or project designed to identify and explain: – criteria involved in selecting a network protocol – characteristics of the TCP/IP suite that contribute to its extensive use – the basic function of application, transport and network protocols that operate within the TCP/IP suite – layers of the Open System Interconnection (OSI) reference model on which each of the TCP/IP protocols operate	25
• demonstrate basic knowledge of logical addressing, and the use of subnets and subnet masks to maximize address utilization	• a teacher-directed evaluation or project designed to test the student's ability to describe and/or illustrate: – conventions for IP addressing – the characteristics of Class A, B and C addresses – the purpose of subnetting and default gateways – classful versus classless approaches to subnetting – static versus dynamic approaches to IP addressing – the function of well-known TCP/UDP (User Datagram Protocol) ports	30
• demonstrate ability to: – install and configure TCP/IP on a user workstation – validate, troubleshoot and manage a network connection using TCP/IP utilities	• a project designed to demonstrate ability to: – build a small peer-to-peer or server-based network – use appropriate processes and settings to install and configure a workstation for TCP/IP – use appropriate TCP/IP utilities to validate, troubleshoot and manage a network connection	30
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – safety regulations specific to the networking technologies being used *Assessment Tools* *Assessment Checklist: Network Protocols (ELT2340–1)* *Assessment Checklist: Laboratory Procedures and Safety Practices, ELTPSP* *Standard* *Performance rating of 2 on each criterion*	5

COURSE ELT2340: NETWORK PROTOCOLS (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate basic competencies.	*Assessment of student achievement should be based on:* • observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Outcomes	Notes
Network Protocols	*The student should:* • describe the nature and purpose of a protocol and a protocol suite/stack within the context of computer networking • describe and compare standard networking protocol suites, including Transmission Control Protocol/Internet Protocol (TCP/IP), Internetwork Packet Exchange/Sequenced Packet Exchange (IPX/SPX), NetBIOS Enhanced User Interface (NetBEUI), and AppleTalk, with respect to: – function – routing – addressing requirements – interoperability – naming conventions – advantages and limitations • match communication tasks performed within TCP/IP, IPX/SPX, NetBEUI and AppleTalk to communication tasks defined at different layers of the Open System Interconnection (OSI) reference model • identify criteria involved in selecting a network protocol.	Computers need to use the same language in order to communicate successfully on a network. In computer networking, these languages are known as protocols. Even though a computer may have the appropriate network operating system, an operational network interface card, and the appropriate network cable, communication is not able to occur without a network protocol. It is common practice to install more than one network protocol on each computer in a network. Illustrate/diagram the relationship of each protocol suite to the OSI reference model.

Concept	Specific Outcomes	Notes
Transmission Control Protocol/Internet Protocol (TCP/IP)	*The student should:* • describe the general characteristics and features of the TCP/IP suite • compare and contrast the TCP/IP suite with the OSI reference model • provide reasons for the extensive use of the TCP/IP suite; e.g.: – universal interconnectivity – conformity with the OSI reference model – modularity – Internet addressing – interoperability • identify the basic function of protocols operating within the TCP/IP suite; e.g.: – Transmission Control Protocol (TCP) – User Datagram Protocol (UDP) – Internet Protocol (IP) – Address Resolution Protocol (ARP) – File Transfer Protocol (FTP) – Simple Mail Transfer Protocol (SMTP) – Post Office Protocol (POP) – Internet Mail Access Protocol (IMAP) – Internet Control Message Protocol (ICMP) – Routing Information Protocol (RIP) – Open Shortest Path First (OSPF) – Hypertext Transfer Protocol (HTTP) • match TCP/IP protocols to layers of the OSI reference model on which they operate • compare and contrast TCP and UDP segment formats.	TCP/IP is the industry-standard suite of protocols, but is often recognized as the Internet protocol. It is designed for wide area networks and as a result is a routable protocol. TCP/IP uses a number of protocols, including the two primary protocols TCP and IP. Features of TCP include: • connection-oriented • reliability • packet handling • error-checking. Explain and/or diagram the: • TCP/IP three-way handshake/open connection • TCP/IP simple acknowledgement and windowing • IP datagram. Describe ICMP testing. Identify three or more ICMP messages.
Logical Addressing	• describe and illustrate conventions for Internet Protocol (IP) addressing; i.e.: – structure and components – characteristics of Class A, B and C addresses • convert between binary and decimal notation • explain the purpose of subnetting and default gateways	Briefly discuss Class D, E and special network addresses.

Concept	Specific Outcomes	Notes
Logical Addressing (continued)	*The student should:* • describe and compare classful and classless approaches to subnetting • provide a rationale for implementing Classless Inter-Domain Routing (CIDR) • demonstrate processes for subnetting a Class A, B or C address into a given number of subnetworks • determine the subnet mask for a subnetted network • describe and compare static and dynamic approaches to IP addressing, and applications of Dynamic Host Configuration Protocol (DHCP) • describe the concept of address resolution, and applications of the Address Resolution Protocol (ARP): – diagram how ARP is used in address resolution – describe gratuitous and proxy ARP – interpret an ARP cache • describe the concept of TCP and UDP port numbers: – define the function of a port – identify the range of port numbers – explain the function of well-known TCP/UDP ports.	Discuss and compare IP (version 4) and IP (version 6) addresses. Compare and contrast the IP and IPX logical addressing schemes. Students should understand the process of assigning a subnet mask to an IP address and be able to: • recognize default subnet masks • identify network and host IDs • define a custom subnet mask • determine local and remote hosts.
Installation, Configuration and Troubleshooting	• identify criteria involved in: – network planning – selecting a network protocol • plan and construct a small peer-to-peer or server-based network	

COURSE ELT2340: NETWORK PROTOCOLS (continued)

Concept	Specific Outcomes	Notes
Installation, Configuration and Troubleshooting (continued)	*The student should:* • install and configure a workstation for TCP/IP: – identify options for obtaining IP addresses – assign a static IP address – assign a subnet mask to an IP address • validate, troubleshoot and manage a network connection through the use of appropriate TCP/IP utilities; e.g.: – Simple Network Management Protocol (SNMP) – Packet Internet Groper (PING) – Internet Protocol Configuration (IPCONFIG) – Trace Route (TRACERT) – Network Statistics (NETSTAT).	Demonstrate the use of appropriate commands for verifying address configuration.

COURSE ELT2350: LOCAL AREA NETWORKS

Level: Intermediate

Theme: Computer Networking Systems

Prerequisite: None

Description: Students extend their understanding of technologies used in a local area network (LAN) and examine specifications for an Ethernet LAN. They develop knowledge of a general strategy for network design and apply the strategy to design, implement and troubleshoot a small LAN.

Parameters: Designed to be delivered in conjunction with other intermediate level courses in the Computer Networking Systems theme. Schools have the option of delivering courses within this theme in conjunction with one or more Project courses from the Career Transitions theme if they wish to extend learning and/or address other vendor-specific technologies.

Access to a computer work centre equipped with networking hardware, software, tools and consumable supplies, and to instruction from an individual with specialized knowledge and skills in computer networking.

Particular emphasis is placed on IEEE standards for cabling, and on safe procedures for preparing and connecting network media and devices. Students model and assume personal responsibility for ethical behaviour in their use of networking technologies and in their access to electronic sources of information. They also demonstrate an understanding of industry-based policies regarding network use and security.

Supporting Courses: ELT1010: Electro-assembly 1, ELT1060: Digital Technology 1, ELT2070: Computer Technology, INF2010: Workstation Operations, INF2190: Telecommunications 1

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• describe and explain the nature and evolution of LAN technologies and the specific features that differentiate one LAN from another	• a teacher-directed evaluation designed to test ability to: – identify and describe the general structure and purpose of a LAN – describe and compare past and present LAN technologies, with attention to their respective topologies, protocols and media – explain the physical characteristics and potential data capacities of emerging LAN technologies, and their benefits to the user	10

COURSE ELT2350: LOCAL AREA NETWORKS (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• explain and demonstrate characteristics of an Ethernet LAN and strategies for improving network performance	• a presentation or project designed to explain and demonstrate: – basic characteristics of an Ethernet LAN – cabling and hardware devices that support data delivery across an Ethernet LAN – data transmission issues in a LAN environment – strategies used to improve LAN performance	25
• describe the characteristics, function and benefits of a virtual local area network (VLAN)	• a presentation or project designed to describe or illustrate: – the benefits offered by VLANs, and specific circumstances in which a VLAN might be implemented – the capabilities and functions of port-based, MAC-addressed-based, and protocol-based VLANs – a simple VLAN configuration	10
• design and implement a small LAN	• a project in which the student demonstrates ability to design and implement a small Ethernet LAN suitable for home or office and adhering to the Institute of Electrical and Electronics Engineers (IEEE) standards. The student should: – outline a general strategy for network design – apply the design strategy to design, implement and test a small Ethernet LAN, given a specific set of network requirements	40
• analyze and troubleshoot basic problems related to LAN design and implementation	• the ability to analyze and determine the cause of a LAN implementation problem, within the context of the project above. The student should: – outline a general strategy for troubleshooting network problems – apply the troubleshooting strategy to determine the cause of a LAN implementation problem	10

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – established network use policies and practices – safety regulations specific to the network technologies being used *Assessment Tools* *Assessment Checklist: Local Area Networks (ELT2350–1)* *Assessment Checklist: Laboratory Procedures and Safety Practices, ELTPSP* *Standard* *Performance rating of 2 on each criterion*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Outcomes	Notes
	The student should:	
LAN Technologies	• describe the general structure and purpose of a local area network (LAN) • describe and compare past and present LAN technologies, with attention to their respective topologies, protocols and media; e.g.: – Attached Resource Computer network (ARCnet) – LocalTalk – Ethernet – Token Ring – Fibre Distributed Data Interface (FDDI) – Asynchronous Transfer Mode (ATM) – Wireless LAN (WLAN)	Although Ethernet networks are commonly used in many network environments, there are a number of other technologies available for implementation. Following Ethernet, Token Ring is the most frequently used LAN technology. ARCNet and LocalTalk are examples of past technologies. FDDI and ATM are two high-speed networking standards used in current networking environments. WLAN provides new end-user benefits, and is likely to become widely available in the future.

COURSE ELT2350: LOCAL AREA NETWORKS (continued)

Concept	Specific Outcomes	Notes
LAN Technologies (continued)	*The student should:* • describe new and/or emerging LAN technologies with respect to: – physical characteristics and potential data capacities – new applications and end-user benefits – historical and/or business perspectives that drive development and adoption.	
Ethernet LANs	• describe basic characteristics of an Ethernet LAN: – topology or physical layout – use of Carrier Sense Multiple Access with Collision Detection (CSMA/CD) – specifications for Ethernet LANs • identify and describe cabling and hardware devices that support data delivery across an Ethernet LAN; e.g.: – cabling specifications and options – data flow through hubs, repeaters, bridges and switches – network interface card (NIC) functions and options – the function of terminating resistors • identify data transmission issues in an Ethernet LAN networking environment; e.g.: – latency and bandwidth – contention – congestion and collision – attenuation • explain the concept of segmentation and strategies used to design a collision domain: – describe segmentation of a collision domain by bridges, switches and routers – illustrate the 5-4-3 rule used in 10BaseT networks – design and illustrate a small Ethernet collision domain network	Current Ethernet standards facilitate large, flexible and fast networks. Where older Ethernet networks transmitted data at 10 Mbps, current Ethernet networks can operate at 100 or 1000 Mbps. Twisted-pair wiring and/or fibre-optic wiring have replaced coaxial cable in many hybrid topologies installed throughout the networking industry. Examine data transmission issues in a LAN networking environment, and current/emerging strategies for improving LAN performance. Compare the distinguishing features of two Ethernet frame types. Distinguish between a collision domain and broadcast domain.

Concept	Specific Outcomes	Notes
Ethernet LANs (continued)	*The student should:* • explain applications of bridge and switch technology: – illustrate the function of learning bridges and the Spanning Tree Protocol (STP) – explain the function of switches at the data link layer and network layers – identify different types of switching architecture • store-and-forward and cut-through data transport • half-duplex and full-duplex network access.	Examine the relationship between bridging and switching technology. Explain how switching can affect utilization load and collision rate. Compare and contrast the function of switches at the data link and network layers. Explain the capabilities and limitations of 10BaseT Ethernet, and the advantages/ disadvantages of 100 Mbps and 1000 Mbps Ethernet over 10 Mbps Ethernet environments.
Virtual Local Area Networks (VLANs)	• describe the structure and function of a VLAN • identify the benefits offered by a VLAN, and specific circumstances in which a VLAN might be implemented • describe capabilities and functions of different types of VLANs: – port-based – address-based – protocol-based • illustrate/diagram a simple VLAN configuration.	VLANs are useful for maximizing the efficiency and security of a network. They are logical LANs within a physical LAN. Discuss the benefits of VLANs, and their advantages over multiple LANs.
LAN Design and Implementation	• outline a general strategy for network design; e.g.: – consider the purpose of the network – determine the overall size of the network – select a network topology – determine the type of file system to be used – select network and client operating systems – establish a naming scheme and name conventions – determine the level and type of fault tolerance – establish the type and level of security required	Discuss the need for, and criteria involved in, network planning. Student projects should demonstrate application of configuration concepts that ensure overall network performance.

Concept	Specific Outcomes	Notes
LAN Design and Implementation (continued)	*The student should:* • design and implement a small Ethernet LAN suitable for home or office that adheres to the Institute of Electrical and Electronics Engineers (IEEE) standards; i.e., given a specific set of network requirements: – select an appropriate topology and architecture – recommend a hardware and connectivity solution – implement the solution by following safe procedures for connecting cabling and hardware devices – test the installation.	Examine applications of hardware and software tools in network planning. Review standards and practices for compliant installation of cabling and devices.
LAN Troubleshooting	• describe and compare proactive and reactive approaches to troubleshooting • outline a general strategy for troubleshooting network problems; e.g.: – establish the symptoms – identify the affected area – establish what has changed – select the most probable cause – implement a solution – test the results – recognize the potential effects of the solution – document the solution • identify common network problems related to: – physical topology – client connectivity – wiring and infrastructure • identify sources of support for troubleshooting; e.g.: – hardware/software manuals and help files – manufacturer's web site – technical support via telephone/e-mail • analyze and determine the cause of a LAN implementation problem.	Identify network troubleshooting tools and techniques. Discuss typical problems associated with ring, bus, star, mesh and wireless topologies. Client troubleshooting typically involves hardware, software, cabling, protocols and/or authentication. Wiring problems may relate to installation, attenuation, network device ports and/or cable lengths.

COURSE CURRICULUM AND ASSESSMENT STANDARDS:

SECTION F: ADVANCED LEVEL

The following pages define the curriculum and assessment standards for the advanced level of Electro-Technologies.

> Advanced level courses demand a higher level of expertise and help prepare students for entry into the workplace or a related post-secondary program.

Course ELT3010: Electro-assembly 3 .... F.3
Course ELT3020: Electronic Servicing F.7
Course ELT3030: Power Systems & Services F.11
Course ELT3040: Generation/Transformation F.15
Course ELT3060: Digital Technology 3 .... F.21
Course ELT3070: Digital Applications F.25
Course ELT3080: Microprocessors F.29
Course ELT3090: Microprocessor Interface F.35
Course ELT3100: Analog Communication 3 .... F.41
Course ELT3110: Amplifiers F.49
Course ELT3130: Data/Telemetry Systems F.55
Course ELT3140: Motors F.61
Course ELT3150: Robotics 3 .... F.65
Course ELT3160: Control Applications F.69
Course ELT3310: Network Operating Systems F.73
Course ELT3320: Routing Fundamentals F.79
Course ELT3330: Wide Area Networks F.85
Course ELT3340: Internet Processes F.91
Course ELT3350: Network Management F.97

COURSE ELT3310: NETWORK OPERATING SYSTEMS

Level: Advanced

Theme: Computer Networking Systems

Prerequisite: ELT2310: Network Structures, ELT2320: Network Media & Devices, ELT2330: OSI Model (Open System Interconnection), ELT2340: Network Protocols, ELT2350: Local Area Networks

Description: Students examine the features, advantages and disadvantages of major network operating systems, and the criteria involved in selecting network operating systems that are appropriate in specific networking environments. They develop knowledge and skills required to install and configure different network and client operating systems, and develop a strategy for troubleshooting problems resulting from the installation of operating system software.

Parameters: Designed to be delivered in conjunction with other advanced level courses in the Computer Networking Systems theme. Schools have the option of delivering courses within this theme in conjunction with one or more Project courses from the Career Transitions theme if they wish to extend learning and/or address other vendor-specific technologies.

Access to a computer work centre equipped with networking hardware, software, tools and consumable supplies, and to instruction from an individual with specialized knowledge and skills in computer networking.

Particular emphasis is placed on current versions of commonly used network operating systems (e.g., Microsoft Windows, Novell NetWare, Apple Macintosh, UNIX/Linux) and client operating systems (e.g., Microsoft Windows, Apple Macintosh, UNIX/Linux). Students model and assume personal responsibility for ethical behaviour in their use of networking technologies and in their access to electronic sources of information. They also demonstrate an understanding of industry-based policies regarding network use and security.

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify the generic functions and administrative tasks common to all network operating systems	• a teacher-directed evaluation designed to test knowledge of: – differences between peer-to-peer and server-based networks, and the role of a network operating system in server-based networks – generic tasks and administrative functions common to all network operating systems	5

COURSE ELT3310: NETWORK OPERATING SYSTEMS (continued)

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• describe and compare specific capabilities and functions of current versions of network operating systems in common use	• a presentation or project designed to describe and compare the capabilities and functions of current versions of network operating systems in common use; e.g.: – Microsoft Windows – Novell NetWare – Apple Macintosh – UNIX/Linux	20
• identify and analyze criteria relevant to planning for, selecting and implementing a network operating system	• a presentation or project designed to demonstrate ability to: – explain factors and considerations involved in network planning – identify criteria involved in selecting a network operating system – select network operating systems options that are appropriate in specific networking environments – analyze the needs of a small company and recommend an appropriate network operating system solution	15
• demonstrate ability to install and configure two or more network operating systems and compatible network clients	• a series of projects designed to demonstrate ability to: – install and configure two or more different network operating systems – install and configure a network client to interact with and access the resources of each network operating system that is installed	30
• demonstrate ability to analyze and troubleshoot connectivity problems related to the installation of operating system software	• demonstrated ability to analyze and troubleshoot connectivity problems resulting from the installation of network and/or client operating systems, within the context of the installation projects above, including: – outlining a general strategy for troubleshooting network problems – applying the troubleshooting strategy in specific scenarios	25

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – safety regulations specific to the networking technologies being used *Assessment Tools* *Assessment Checklist: Network Operating Systems (ELT3310–1)* *Assessment Checklist: Laboratory Procedures and Safety Practices, ELTPSP* *Standard* *Performance rating of 3 on each criterion*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Outcomes	Notes
	The student should:	
NOS Functions and Capabilities	• compare and contrast peer-to-peer and server-based networks • describe the role of a network operating system (NOS) in server-based networks; e.g.: – connecting computers and peripheral devices, and servicing requests for resources – managing access to data and shared resources – monitoring performance and activities of the network • identify generic tasks and administrative functions common to all network operating systems; e.g.: – file services – print services – directory services – security services – messaging services – routing services – network administrative services	Compare the features and functions of commonly used network operating systems with respect to: • network services • administrative functions • native protocols • compatible clients • configuration. Distinguish between the functions of a: • network operating system • client operating system • multipurpose operating system.

COURSE ELT3310: NETWORK OPERATING SYSTEMS (continued)

Concept	Specific Outcomes	Notes
NOS Functions and Capabilities (continued)	*The student should:* – • describe and compare the capabilities and functions of network operating systems in common use; e.g., Microsoft Windows, Novell NetWare, Apple Macintosh and UNIX/Linux, with respect to: – evolution and major features – associated protocols and interoperability – client support – authentication and security – file, print and directory services – routing services.	Current versions of major operating systems encourage the use of TCP/IP.
Planning for NOS Implementation	• identify criteria involved in network planning; e.g.: – need for and benefits of network planning – specific criteria and steps involved in network planning • explain criteria involved in selecting a network operating system; e.g.: – client needs/required services – user base and budget – client software and associated protocols – hardware requirements – client licensing • identify hardware devices and software tools used in network planning • identify key differences among common network operating systems • identify network operating systems that are appropriate in specific networking environments • analyze the needs of a small company and recommend an appropriate network operating system	Choosing a network operating system can be a complex task. Although all operating systems enable users to share resources on a network, some operating systems are more suited to the needs of specific networking environments than others. Discuss applications of network design software. Examine the pros and cons of each network operating system. Identify operating systems that are most appropriate in specific networking environments.

Concept	Specific Outcomes	Notes
	The student should:	
NOS Installation and Configuration	• install and configure two or more different network operating systems: – partition and format drive – name server and network – install and configure protocol – select network services – establish and confirm licensing – set administrative passwords – install peripherals – share resources and set permissions	Networking computers requires that: • the server is configured with a network operating system • each client computer is configured with a client operating system • both server and client computers are configured with an appropriate network protocol.
	• install and configure a network client to interact with and access the resources of each network operating system that is installed: – configure an appropriate client operating system – install and configure protocol – assign computer/host name and user name – select network services – set an acceptable/secure password	Client operating systems could include: • Windows • UNIX/Linux • Macintosh.
	• identify the function of and configure common network services; e.g.: – Dynamic Host Configuration Protocol (DHCP) – Bootstrap Protocol (BOOTP) – Domain Name Service (DNS) – Network Address Translation/Internet Connection Sharing (NAT/ICS) – Windows Internet Naming Service (WINS) – Simple Network Management Protocol (SNMP)	
	• demonstrate processes for: – sharing and accessing a folder – assigning permissions – sharing a printer.	Discuss the function of the redirector in client software.

Concept	Specific Outcomes	Notes
	The student should:	
NOS Troubleshooting	• outline a general strategy for troubleshooting network problems; e.g.: – establish the symptoms – identify the affected area – establish what has changed – select the most probable cause – implement a solution – test the results – recognize the potential effects of the solution – document the solution	Identify tests that are used to determine if a link is operational.
	• analyze and troubleshoot connectivity problems resulting from the installation of a network and/or client operating system; i.e.: – use appropriate diagnostic commands and utilities – interpret visual indicators – predict the impact of adding, removing and/or modifying network services	Demonstrate applications of: • telnet • ping command • trace command • Internet Protocol (IP) route command.
	• use protocol analysis software to analyze basic network utilization and frame statistics.	

COURSE ELT3320: ROUTING FUNDAMENTALS

Level: Advanced

Theme: Computer Networking Systems

Prerequisite: ELT2310: Network Structures, ELT2320: Network Media & Devices, ELT2330: OSI Model (Open System Interconnection), ELT2340: Network Protocols, ELT2350: Local Area Networks

Description: Students extend their knowledge of wide area networks (WANs) by examining the process by which information is routed through an internetwork. They examine the major functions and components of a router, develop knowledge of common routing protocols, and gain practical experience in basic router configuration.

Parameters: Designed to be delivered in conjunction with other advanced level courses in the Computer Networking Systems theme. Schools have the option of delivering courses within this theme in conjunction with one or more Project courses from the Career Transitions theme if they wish to extend learning and/or address other vendor-specific technologies.

Access to a computer work centre equipped with networking hardware, software, tools and consumable supplies, and to instruction from an individual with specialized knowledge and skills in computer networking.

Particular emphasis is placed on introductory-level knowledge of the processes used to route information through larger networks, and on the Internet Protocol (IP) addressing scheme. Students model and assume personal responsibility for ethical behaviour in their use of networking technologies and in their access to electronic sources of information. They also demonstrate an understanding of industry-based policies regarding network use and security.

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	

• describe the process of routing data through an internetwork, and describe the major functions of a router	• a teacher-directed evaluation or project designed to test ability to:
	– describe the characteristics of internetworks and the path determination function of a router
	– compare and contrast the functions of bridges, switches, routers and gateways
	– describe and illustrate basic router operation
	– explain and give examples of:
	  • static and dynamic routing
	  • routable and nonroutable protocols
	– construct a physical model of a router topology
		15

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• explain and analyze the addressing and routing function of protocols operating at the network layer of the Open System Interconnection (OSI) reference model	• a presentation or project designed to: – describe and illustrate the function of IP addresses in a routed network – explain and interpret standard conventions for IP addressing – analyze the function of the Address Resolution Protocol (ARP) and interpret an ARP cache – compare local area network (LAN)-to-LAN routing and LAN-to-WAN routing – describe the basic architecture, purpose and function of common routing protocols – explain and give examples of inter-autonomous, intra-autonomous and pass-through routing	15
• demonstrate knowledge of router components, commands and configuration processes	• a series of router configuration projects in which the student demonstrates ability to: – explain external configuration sources and internal configuration components – interpret and use basic router commands – perform basic router configuration routines, including: • router start-up and log-in procedures • use of command history and editing features • configuration and verification of IP addresses • configuration of routing protocols and interface • configuration of standard and extended access lists – prepare a flowchart illustrating the router configuration process – configure a router for a standard 5-router topology	50
• describe and explain methods used to manage and monitor network routing	• a presentation or project designed to explain and demonstrate the use of the Simple Network Management Protocol (SNMP) to manage and monitor network routing	15

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – established network use policies and practices – safety regulations specific to the network technologies being used *Assessment Tools* *Assessment Checklist: Routing Fundamentals (ELT3320–1)* *Assessment Checklist: Laboratory Procedures and Safety Practices, ELTPSP* *Standard* *Performance rating of 3 on each criterion*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Outcomes	Notes
	The student should:	
Basic Routing Concepts	• describe the characteristics of internetworks and the path determination function of a router • compare and contrast the functions of bridges, switches, routers and gateways • describe and illustrate basic router operation: – the routing of data packets from source to destination – the sequence of encapsulation during routing – functions of a routing information table – the nature of commonly used routing metrics • explain and give examples of: – static and dynamic routing – routable and nonroutable protocols • construct a physical model of a router topology.	Plan for activities that examine the function of a router in moving a packet of data from source to destination on an internetwork. Relate routing processes and devices to the Open System Interconnection (OSI) reference model. Compare routing and switching processes at the network layer. Describe components of a routing table and features of static and dynamic routing. Identify some routing metrics.

COURSE ELT3320: ROUTING FUNDAMENTALS (continued)

Concept	Specific Outcomes	Notes
Addressing and Routing Protocols	*The student should:* • describe and illustrate the function of IP addresses in a routed network: – host addresses and broadcast addresses – subnetting and default gateways • explain and interpret standard conventions for IP addressing: – IP version 4 (Class A, B and C) addresses and their default subnet masks – Classless Inter-Domain Routing (CIDR) and the format for IP version 6 addresses • identify and describe ways in which IP version 6 may affect routing • analyze the function of the Address Resolution Protocol (ARP) and interpret an ARP cache • compare major features of LAN-to-LAN routing and LAN-to-WAN routing • describe and give examples of: – distance-vector and link-state routing protocols – interior and exterior routing protocols • explain the basic architecture and operation of common routing protocols; i.e.: – Routing Information Protocol (RIP) – Open Shortest Path First (OSPF) – Border Gateway Protocol (BGP) • explain and give examples of inter-autonomous, intra-autonomous and pass-through routing.	Compare internetwork routing to the postal system's method of routing mail. Explain the function of IP addressing in making limitless connections available on internetworks. Distinguish between open/standardized routing architectures and proprietary (i.e., privately owned) architectures. Identify steps of the Bellman-Ford Distance Vector Algorithm. Investigate the counting to infinity problem and how: • RIP resolves the problem • split horizon prevents the problem. Diagram: • three OSPF phases • a BGP internetwork.
Router Components, Commands and Configuration	• identify and describe external configuration sources and internal configuration components • describe the uses of random-access memory (RAM) for working storage in a router • identify and describe router modes • identify and describe router help functions • interpret and use: – router interface and interface modes – basic show and test commands – startup sequence and setup commands – configuration files and modes	Basic router commands and configuration processes will vary according to the nature of the hardware being used. Compare and contrast user and privileged router modes.

COURSE ELT3320: ROUTING FUNDAMENTALS (continued)

Concept	Specific Outcomes	Notes
Router Components, Commands and Configuration (continued)	*The student should:* • perform basic router configuration routines: – demonstrate router startup and log-in procedures – use command history and editing features – configure and verify IP addresses – configure routing protocols and interface – configure standard and extended access lists • demonstrate ability to troubleshoot a routing loop • prepare a flowchart illustrating the router configuration process • configure a router for a standard 5-router topology.	Identify types of information contained in a router configuration file. Specify files required for successful startup and functioning. Describe the IP route command. Configure a static route between neighbouring routers using the IP route command.
Network Monitoring and Management	• describe Simple Network Management Protocol (SNMP) and its purpose in routing • identify SNMP architecture and message formats • describe management information base (MIB) structure and name representation • identify basic SNMP commands and security levels • demonstrate ability to: – configure an SNMP community name and access rights – troubleshoot a problem related to community access rights – display and save event logs – send traps to a specific IP station.	Examine SNMP with respect to: • levels, agents and communities • events, traps and trap-directed polling. Diagram MIB structure. Identify generic SNMP traps and types of events that can be trapped. Discuss the function of SNMP thresholds in measuring network performance against established baselines.

COURSE ELT3330:	**WIDE AREA NETWORKS**
Level:	Advanced
Theme:	Computer Networking Systems
Prerequisite:	ELT2310: Network Structures, ELT2320: Network Media & Devices, ELT2330: OSI Model (Open System Interconnection), ELT2340: Network Protocols, ELT2350: Local Area Networks
Description:	Students develop basic knowledge of the technologies employed in a wide area network (WAN) and of how a WAN may be used to connect local area networks (LANs) at different locations. They gain practical experience in using WAN technologies to establish remote network access, and they analyze emerging WAN technologies with respect to impact on global networking.
Parameters:	Designed to be delivered in conjunction with other advanced level courses in the Computer Networking Systems theme. Schools have the option of delivering courses within this theme in conjunction with one or more Project courses from the Career Transitions theme if they wish to extend learning and/or address other vendor-specific technologies. Access to a computer work centre equipped with networking hardware, software, tools and consumable supplies, and to instruction from an individual with specialized knowledge and skills in computer networking. Particular emphasis is placed on introductory-level knowledge of WAN concepts, and on the application of WAN technologies. Students model and assume personal responsibility for ethical behaviour in their use of networking technologies and in their access to electronic sources of information. They also demonstrate an understanding of industry-based policies regarding network use and security.

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• describe the general structure, function and communication services provided by a WAN	• a teacher-directed evaluation designed to test ability to: – describe and illustrate the basic structure and function of a WAN – differentiate between and give examples of analog and digital carrier systems and services – describe basic processes of modulation, synchronization and multiplexing in a WAN	15

COURSE ELT3330: WIDE AREA NETWORKS (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• explain and illustrate basic concepts of circuit switching and packet switching and their application in a WAN	• a presentation or project designed to: – explain and illustrate how a typical circuit-switching and packet-switching session works – describe the physical characteristics (i.e., speed, capacity, media), basic function and user services offered by common circuit-switching and packet-switching technologies – compare the quality of service (QoS) offered by selected circuit-switching and packet-switching technologies	25
• demonstrate applications of WAN technology in providing network users with remote access	• a project in which the student demonstrates ability to: – describe and compare different approaches used to provide network users with remote access – explain the function of a remote access server (RAS) and common remote access protocols and services – select an approach, protocol and configuration; implement remote access; and troubleshoot and identify the cause of potential connection problems, given a need for remote connectivity in a small office or home office scenario	30
• identify and describe security issues in a WAN and the function of network security protocols and methods	• a presentation or project identifying and describing: – major security issues in a WAN – the purpose and function of common security protocols – the purpose, characteristics and benefits of firewalls and proxies	10
• analyze emerging WAN technologies with respect to design, evolution and impact on global networking	• a presentation or project identifying three or more emerging WAN technologies and analyzing each with respect to: – elements of design – historical evolution – benefits provided to global networking	15

COURSE ELT3330: WIDE AREA NETWORKS (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – established network use policies and practices – safety regulations specific to the network technologies being used *Assessment Tools* *Assessment Checklist: Wide Area Networks (ELT3330–1)* *Assessment Checklist: Laboratory Procedures and Safety Practices, ELTPSP* *Standard* *Performance rating of 3 on each criterion*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Outcomes	Notes
	The student should:	
WAN Characteristics	• describe and illustrate the basic structure and function of a WAN • compare and contrast the structure of, and communication services provided by: – local area networks (LANs), metropolitan area networks (MANs) and WANs – public networks, private networks and virtual private networks (VPN) • describe and give examples of: – analog and digital carrier systems and services – major standards for digital carrier services; e.g.: • data signaling (DS) standards • T- and E-carrier standards • describe basic processes of modulation, synchronization and multiplexing in a WAN	Prior to computer networking, telephone companies had developed the Public Switched Telephone Network (PSTN). Discuss the significance and relationship of PSTN to WAN development. VPNs combine the advantages of public and private networks. Identify reasons for implementing VPNs in specific situations. Compare baseband and broadband communication and their application in LAN and WAN environments.

Concept	Specific Outcomes	Notes
WAN Characteristics (continued)	*The student should:* • describe and compare: – dial-up and dedicated connections – asynchronous and synchronous modems • identify common types of lease lines and the advantages and disadvantages associated with dedicated lease lines.	
Switching Technologies	• explain and illustrate how a typical circuit-switching and packet-switching session works • compare design features of switched virtual circuits and permanent virtual circuits • describe the physical characteristics (i.e., speed, capacity, media), basic function and user services offered by: – common circuit-switching technologies, including: • Integrated Services Digital Network (ISDN) • Digital Subscriber Line (DSL) – common packet-switching technologies, including: • x.25 • Frame Relay • Asynchronous Transfer Mode (ATM) • Synchronous Optical Network/Synchronous Digital Hierarchy (SONET/SDH) • define the concept of quality of service (QoS) • compare the QoS offered by selected circuit-switching and packet-switching technologies • explain WAN design considerations related to: – committed information rate (CIR) – error rate and packet loss.	Plan for activities that compare circuit-switching and packet-switching technologies with respect to: • basic processes and transfer modes • related services and applications. Examine the basic operation of an ATM network, and compare ATM with traditional networking technologies. Explain how LAN Emulation (LANE) and Multiprotocol Over ATM (MPOA) enable ATM to integrate with traditional networks. Discuss the influence of QoS on WAN design and the way information is transmitted in a WAN.

COURSE ELT3330: WIDE AREA NETWORKS (continued)

Concept	Specific Outcomes	Notes
	The student should:	
Remote Access	• describe and compare different approaches used to provide network users with remote access; i.e.: – dial-up connections – VPN connections • explain the function of a remote access server (RAS) and common remote access protocols and services; e.g.: – Serial Line Internet Protocol (SLIP) – Point-to-Point Protocol (PPP) – Point-to-Point Tunneling Protocol (PPTP) – Independent Computing Architecture (ICA) • recommend a remote access connectivity solution, select a remote access protocol/service, configure client and server for remote access, and troubleshoot potential connection problems, given a need for remote connectivity in a small office or home office scenario.	Remote access allows users to connect to a network from a remote location through dial-up lines and high-speed connections. Plan for activities that enable students to: • choose the approach, protocol and configuration for a given remote connectivity situation • identify the cause of network, connection or authentication failure in a situation involving dial-up or dedicated services.
Network Security	• identify internal and external security issues in a WAN • identify the purpose and components of a network security policy • describe/illustrate the purpose and function of common security protocols; e.g.: – Internet Protocol Security (IPSec) – Kerberos – Layer 2 Tunneling Protocol (L2TP) – Secure Sockets Layer (SSL) • explain the purpose, characteristics and benefits of: – a firewall – a proxy server • predict the impact of implementing a particular security strategy on network functionality.	Network security involves protecting networks from internal threats, such as unauthorized access and accidental data destruction, as well as protecting networks from external threats by hackers and viruses. Demonstrate processes for configuring: • password policies • security options • audit policy.

Concept	Specific Outcomes	Notes
Emerging Technologies	*The student should:* • identify and briefly describe five or more emerging WAN technologies • analyze three or more emerging WAN technologies, including any of the following, with respect to elements of design, historical evolution and benefits to global networking: – Plain Old Telephone System (POTS), xDSL, ISDN and cable as examples of last mile solutions – technologies designed to address bandwidth requirements – Internet Protocol version 6 (IPv6) – tunneling protocols – VPN solutions – wireless/satellite networks – Internet telephony.	Discuss relationships between: • technological development and the needs of society • emerging technologies and unified networks. Research phases and methodology of network design. Discuss: • the role of carrier extensions and frame bursting in Gigabit Ethernet • advantages of IPv6 or IPv4 • Dense Wavelength Division Multiplexing (DWDM) as a solution for exhausted SONET lines • recent technologies designed to enhance wireless transmission • advantages of unifying data and voice networks.

COURSE ELT3340: **INTERNET PROCESSES**

Level: Advanced

Theme: Computer Networking Systems

Prerequisite: ELT2310: Network Structures, ELT2320: Network Media & Devices, ELT2330: OSI Model (Open System Interconnection), ELT2340: Network Protocols, ELT2350: Local Area Networks

Description: Students apply their knowledge of wide area network (WAN) technologies to an Internet environment. Course content focuses on the significance and utility of Internet Protocol (IP) addressing schemes in Internet communication and on the function of WAN protocols and services in providing Internet access. Students develop knowledge of internetworking career paths and related educational opportunities.

Parameters: Designed to be delivered in conjunction with other advanced level courses in the Computer Networking Systems theme. Schools have the option of delivering courses within this theme in conjunction with one or more Project courses from the Career Transitions theme if they wish to extend learning and/or address other vendor-specific technologies.

Access to a computer work centre equipped with networking hardware, software, tools and consumable supplies, and to instruction from an individual with specialized knowledge and skills in computer networking.

Particular emphasis is placed on reinforcing and applying previously developed knowledge and skills in an Internet environment, and on explaining how and why particular technologies are employed. Students model and assume personal responsibility for ethical behaviour in their use of networking technologies and in their access to electronic sources of information. They also demonstrate an understanding of industry-based policies regarding network use and security.

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• describe and analyze the historical roots, basic architecture and functions of the Internet in global communication	• a test, presentation or project designed to address the: – origin and evolution of the Internet – basic architecture of the Internet – nature and function of services provided by the Internet – contributions of emerging technologies in global Internet communication	15

COURSE ELT3340: INTERNET PROCESSES (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• develop a rationale for, and demonstrate the use of, IP addressing schemes, subnets and subnet masks in Internet communication	• a presentation or project designed to demonstrate: – the nature of IP addressing, subnets and subnet masks, and their use with IP networks – ability to identify classes of IP addresses, to subnet addresses, to identify subnet masks, and to optimize host/subnet schemes – problems and solutions associated with traditional IP addressing	30
• explain and compare the function of selected WAN protocols and services, and their utility in providing access to the Internet	• a presentation or project that explains and compares, within the context of an Internet environment, common WAN protocols and services with respect to: – function – architecture – configuration – benefits – possible design issues	25
• identify and assess methods for connecting a local network infrastructure with the Internet	• a project designed to: – identify and assess methods for connecting a network to the Internet – plan and implement an appropriate strategy for Internet connectivity, given needs within a local network for access to the Internet	15
• identify and describe internetworking career paths and employment opportunities, as well as related education and certification requirements	• a project or report identifying technical and professional internetworking career paths and employment opportunities, and related education and certification requirements. The student should also organize a portfolio and résumé suitable to present qualifications for a selected entry-level networking position	10

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – established network use policies and practices – safety regulations specific to the network technologies being used *Assessment Tools* *Assessment Checklist: Internet Processes (ELT3340–1)* *Assessment Checklist: Laboratory Procedures and Safety Practices, ELTPSP* *Standard* *Performance rating of 3 on each criterion*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Outcomes	Notes
	The student should:	
Nature and Origin of the Internet	• describe the origin and evolution of the Internet, from the building of the Advanced Research Projects Agency (ARPA) network in the 1960s to its present existence as a public network • describe and illustrate the basic architecture of the Internet; i.e.: – Internet backbone – metropolitan area Ethernets (MAEs) – network access points (NAPs) – Internet access providers (IAPs) – Internet service providers (ISPs) • explain the nature and function of services provided by the Internet • analyze the impact of the Internet on economic, social and political systems	Until the early 1990s, many people were not aware of the Internet's existence. Discuss innovations leading to the rapid development and adoption of the Internet. Distinguish between the services provided by IAPs and ISPs. Discuss applications of virtual private networks (VPNs) in tunneling private corporate data through the public Internet.

Concept	Specific Outcomes	Notes
	The student should:	
Nature and Origin of the Internet (continued)	• identify and explain contributions of emerging technologies in global Internet communication; e.g.: – Internet over Satellite (IoS) – Internet telephony.	Research advantages offered by IP for unifying data and voice networks. Discuss benefits and applications of Voice over IP (VoIP) products.
IP Addressing Schemes	• explain the function of Internet Protocol (IP) addressing, subnets and subnet masks in Internet communication • describe methods for assigning an IP address • identify classes of IP addresses and the purpose of reserved address space • subnet a Class A, B or C address into a given number of subnetworks • determine the subnet mask for a subnetted network • optimize a host/subnet scheme • compare connectionless and connection-oriented networking processes • identify problems and solutions associated with traditional IP addressing • identify advantages of Internet Protocol version 6 (IPv6) over Internet Protocol version 4 (IPv4).	Compare IP multicasting, unicasting and broadcasting. Perform the Boolean AND function to obtain a network number. Compare public and private addresses.
WAN Protocols and Services	• explain the significance of the Transmission Control Protocol/Internet Protocol (TCP/IP) suite within an Internet environment	Provide opportunities for students to apply previously developed knowledge of WAN protocols to an Internet environment. Relate each protocol to: • its function within the context of the Internet • relevant layers of the OSI model.

Concept	Specific Outcomes	Notes
WAN Protocols and Services (continued)	*The student should:* • describe common WAN protocols and services, including Dynamic Host Configuration Protocol (DHCP), Address Resolution Protocol (ARP), Domain Name Service (DNS), Integrated Services Digital Network (ISDN), and Point-to-Point Protocol (PPP), with respect to: – function – architecture – configuration – benefits – possible design issues.	Identify services from the TCP/IP suite that are used in: • file transfer • electronic mail • the World Wide Web.
Internet Access	• identify criteria involved in network planning • identify and assess options for connecting a network to the Internet; i.e.: – accessing the Internet backbone – choosing an Internet service provider (ISP) – selecting a WAN connection strategy – procuring a domain name – obtaining the required number of IP addresses – addressing security issues • describe methods for securing IP traffic between a local network and a service provider; e.g.: – firewalls – Internet Protocol Security (IPSec) – proxy servers • explain applications of Network Address Translation (NAT) in sharing an Internet connection • plan and implement a strategy for Internet connectivity, given needs within a local network for access to the Internet.	Discuss factors to consider when selecting an ISP; e.g.: • the ISP's service • redundant connections • proximity to an NAP. Identify pros and cons associated with WAN technologies in connecting to the Internet; e.g.: • T-lines • Frame Relay • Digital Subscriber Line.

COURSE ELT3340: INTERNET PROCESSES (continued)

Concept	Specific Outcomes	Notes
	The student should:	
Career Paths	• identify technical and professional internetworking career paths and employment opportunities • place internetworking job titles in a progression sequence • write a detailed internetworking position description • describe related post-secondary and/or industry education/certification requirements and opportunities • organize a portfolio and résumé suitable to present qualifications for a selected entry-level networking position.	Plan for individual/group research and presentations that address: • job description • employment market • education/training • salary range. Research and describe available industry networking certification tracks. Arrange/facilitate: • information interviews • work study/experience • job shadowing.

COURSE ELT3350:	**NETWORK MANAGEMENT**
Level:	Advanced
Theme:	Computer Networking Systems
Prerequisite:	ELT2310: Network Structures, ELT2320: Network Media & Devices, ELT2330: OSI Model (Open System Interconnection), ELT2340: Network Protocols, ELT2350: Local Area Networks
Description:	Students acquire knowledge of internal and external risks to a network and develop strategies for protecting network data and securing a network. They also develop and apply a general strategy for troubleshooting network problems and acquire knowledge of the basic roles and responsibilities associated with network maintenance and support.
Parameters:	Designed to be delivered in conjunction with other advanced level courses in the Computer Networking Systems theme. Schools have the option of delivering courses within this theme in conjunction with one or more Project courses from the Career Transitions theme if they wish to extend learning and/or address other vendor-specific technologies. Access to a computer work centre equipped with networking hardware, software, tools and consumable supplies, and to instruction from an individual with specialized knowledge and skills in computer networking. Particular emphasis is placed on risks and problems most common to a small network, and on the ability to apply troubleshooting strategies, tools and commands in specific situations. Students model and assume personal responsibility for ethical behaviour in their use of networking technologies and in their access to electronic sources of information. They also demonstrate an understanding of industry-based policies regarding network use and security.

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • provide a rationale for protecting network data, and describe major components of a data backup strategy	*Assessment of student achievement should be based on:* • a test, presentation or project designed to address the following topics: – a rationale for protecting data in a LAN that addresses the nature, scope and source of potential risks – major components of a data backup strategy – the design of an appropriate data backup strategy, given a small office or home office network scenario	20

COURSE ELT3350: NETWORK MANAGEMENT (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• analyze security risks in a local area network (LAN), and describe steps that can be taken to secure a network	• a test, presentation or project designed to address the following topics: – a rationale for network security that addresses the nature, scope and source of internal and external security risks – the characteristics of threats imposed by viruses, worms and Trojan horses, and through direct attack – strategies for protecting a LAN from internal and external risks – the design of an appropriate security plan	15
• demonstrate an understanding of the functions and key roles of network maintenance and support in an organization	• a presentation or project designed to outline considerations, tasks and actions that are required to maintain and support an operating network; the presentation or project should address key functions and roles related to but not limited to: – network maintenance policies – network documentation – vendor upgrades – system backup	25
• use appropriate strategies, tools and commands to troubleshoot common network problems	• a series of projects in which the student: – describes common sources of network problems in a LAN – demonstrates the safe use of troubleshooting tools – demonstrates ability to use appropriate software commands to check configuration or connectivity – demonstrates how packet sniffing software is used to capture and analyze data packets and frames – outlines a general strategy for troubleshooting network problems – uses appropriate strategies, tools and commands to troubleshoot common network problems	25
• identify and describe career paths and employment opportunities in network maintenance and support	• a project or report identifying technical and professional career paths and employment opportunities in network administration, maintenance and support, and related education and certification requirements. The student should also refine a portfolio and résumé suitable to present qualifications for a selected entry-level networking position	10

COURSE ELT3350: NETWORK MANAGEMENT (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• demonstrate established laboratory procedures and safe work practices	• observed performance in following: – established laboratory procedures – established network use policies and practices – safety regulations specific to the network technologies being used *Assessment Tools* *Assessment Checklist: Network Management (ELT3350–1)* *Assessment Checklist: Laboratory Procedures and Safety Practices, ELTPSP* *Standard* *Performance rating of 3 on each criterion*	5
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Outcomes	Notes
	The student should:	
Data Backup	• give reasons for protecting data in a LAN • describe the nature, scope and source of potential risks to data in a LAN • identify and describe major components of a data backup strategy; i.e.: – redundancy – fault tolerance – data backup – uninterruptible power supply • design an appropriate data backup strategy, given a small office or home office network scenario.	Data backup decisions made by a local administrator take into account the needs of the network and its organization, and will include: • what data to back up • how frequently to back up • the type of backup to create • where to store the backup media.

Concept	Specific Outcomes	Notes
	The student should:	
Network Security	• give reasons for network security • describe the nature, scope and source of internal and external security risks in a LAN environment • identify the characteristics of threats imposed by: – viruses, worms and Trojan horses – direct attack; e.g.: • eavesdropping • password attacks • Internet Protocol (IP) address spoofing • identify and describe strategies for protecting a LAN from internal and external risks; i.e.: – user authentication, access permissions and account options – share permissions and user group access rights – virus protection – firewalls – data encryption • design an appropriate security plan, given a small office or home office network scenario.	Network security involves the protection of network resources from attacks that originate both inside and outside the network. The first line of defence for network security is user authentication. Firewalls are hardware and software devices that can control the flow of data packets between an internal network and an external network such as the Internet. A network security plan should identify possible security risks to the network and methods that will be used to minimize security risks.
Network Troubleshooting	• describe the most common sources of network problems in a LAN; e.g.: – user error – software – physical connectivity • demonstrate the safe use of troubleshooting tools; e.g.: – cable tester – crossover cable – digital voltmeter – protocol analyzer – tone generator/tone locator • demonstrate the use of appropriate software commands to check configuration or connectivity; e.g.: – IPCONFIG – PING – TRACERT	Compare proactive and reactive approaches to network troubleshooting. Interpret visual indicators (e.g., link lights, collision lights) to determine the nature of a network problem. Demonstrate the use of network monitoring software and protocol analyzers.

Concept	Specific Outcomes	Notes
	The student should:	
Network Troubleshooting (continued)	• outline a general strategy for troubleshooting network problems; e.g.: – establish the symptoms – identify the affected area – establish what has changed – select the most probable cause – implement a solution – test the results – recognize the potential effects of the solution – document the solution • use appropriate strategies, tools and commands, given a small office or home office network scenario, to troubleshoot common network problems related to: – a particular physical topology – client connectivity – wiring and/or infrastructure – remote connectivity.	Effective troubleshooting requires: • accurate documentation • a systematic approach • working from the basic to the complex.
Network Maintenance and Support	• outline considerations that are required to maintain and support an operating network; e.g.: – anticipated activities – data integrity – hardware and software standards – repair policies – system monitoring – training • identify benefits associated with network maintenance and support • identify and describe key functions and roles related to network maintenance and support activities; e.g.: – network maintenance policies – network documentation – vendor upgrades – system backup • identify hardware devices/software tools used to gather information to assist network maintenance and support activities • develop a plan to maintain and support an operating network.	Network maintenance should occur as a result of a planned, documented and structured process. Discuss major criteria and benefits associated with network maintenance and support.

Concept	Specific Outcomes	Notes
Career Paths	*The student should:* • identify technical and professional career paths and employment opportunities in network administration, maintenance and/or support • place network administration, maintenance and/or support job titles in a progression sequence • write a detailed network administration, maintenance and/or support position description • describe related post-secondary and/or industry education/certification requirements and opportunities • organize/refine a portfolio and résumé suitable to present qualifications for a selected entry-level networking position.	Plan for individual/group research and presentations that address: • job description • employment market • education/training • salary range. Research and describe available industry networking certification tracks. Arrange/facilitate: • information interviews • work study/experience • job shadowing.

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STANDARD	Students working at standard must demonstrate the requirements outlined in the checklist below to the standard as indicated in module assessment criteria and conditions. The minimum rating for *at standard* performance for introductory is 1, intermediate 2, and advanced level modules 3. Refer to generic rating scale that further defines competencies at the various levels.				
Scale	**Teacher Direction/Support/ Student Initiative**	**Problem Solving**	**Use of Tools/Materials/ Processes**	**Standards of Quality/ Productivity**	**SUMMARY STATEMENTS** ***the student has:***
4	Student outlines project with no teacher guidance.	Student prepares plan of action, makes creative adjustments to ensure final outcome and expected outcome.	Student selects most appropriate tools, most efficient process.	No errors or deficiencies are noted. Standards of quality and productivity exceed defined outcomes.	***REFLECTIONS/ COMMENTS:***
3 minimum at advanced level	Student outlines project/plan action with minimal teacher guidance.	Student prepares and follows detailed plan of action and expected outcome.	Student selects appropriate tools and processes.	No errors or deficiencies are noted. Standards of quality and productivity are consistent.	
2 minimum at intermediate level	Teacher outlines project and expected outcomes and student has input to plan of action.	Student follows plan of action with minimal assistance.	Appropriate uses/follows as prescribed.	Minor errors/deficiencies are evident. Standards of quality and productivity occasionally inconsistent.	
1 minimum at introductory level	Teacher outlines project and detailed plan of action.	Student follows plan of action with assistance.	Uses/follows as prescribed with occasional errors.	Some errors/deficiencies are evident. Standards of quality and productivity often inconsistent.	
Incomplete					

ASSESSMENT CHECKLIST: Laboratory Procedures and Safety Practices

ELTPSP

STANDARD	Students working **at standard** must demonstrate the behaviours outlined in the checklist below. The columns to the left of the checklist indicate the minimum *standard of performance* for introductory, intermediate and advanced level courses. The rating scale on the right-hand defines each of the minimum standards of performance and should be applied when assessing student achievement.

Observed Rating	Minimum Standard (Intro. Level)	Minimum Standard (Inter. Level)	Minimum Standard (Adv. Level)	CRITERIA
___	1	2	3	***The student:*** **Personal Management:** ☐ prepares self for task ☐ organizes and works in an orderly manner ☐ uses time effectively ☐ demonstrates ethical use of information and communication technologies ☐ complies with local policies regarding network use and security ☐ ________________
___	1	2	3	**Laboratory Routines:** ☐ follows established routines ☐ demonstrates responsibility for housekeeping ☐ identifies risks to health and safety that result from improper use of technology ☐ assesses new physical environments with respect to ergonomics ☐ follows safety regulations specific to the technologies being used ☐ anticipates potential safety hazards and emergency response ☐ ________________
___	1	2	3	**Tools and Equipment:** ☐ identifies appropriate tools and hardware/software ☐ uses tools and hardware/software in an appropriate manner ☐ downloads and transmits only materials that comply with established network use policies and practices ☐ uses personal protective devices as required ☐ stores tools and hardware/software as instructed ☐ ________________

Rating Scale

The student:

4	exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. Quality, particularly details and finishes, and productivity are consistent and exceed standards. Leads others to contribute to team goals.
3	meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. Quality and productivity are consistent. Works cooperatively and contributes ideas and suggestions that enhance team effort.
2	meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. Quality and productivity are reasonably consistent. Works cooperatively to achieve team goals.
1	meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. Quality and productivity are reasonably consistent. Works cooperatively.
0	has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

COMMENTS

Student Name: ______________________ Teacher: ______________________

Course/Project(s): ______________________ Date: ______________________

CRITERIA	OBSERVATION/ RATING	STANDARD
Management	4 3 2 1 0	2
Teamwork	4 3 2 1 0	2
Basic Concepts	4 3 2 1 0	2
Application and Utilization	4 3 2 1 0	2

STANDARD IS 2 IN EACH APPLICABLE CRITERION UNLESS OTHERWISE STATED

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately.

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately.

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

CRITERIA

The student:

Management
- ☐ interprets and carries out instructions accurately
- ☐ plans and uses time effectively in a logical sequence
- ☐ complies with established network use policies and practices
- ☐ uses personal initiative to formulate questions and find answers
- ☐ gathers and responds to feedback regarding approach to task and project status
- ☐ attempts to solve problems prior to requesting help
- ☐ demonstrates ethical use of information technologies and sources

Teamwork
- ☐ cooperates with group members
- ☐ shares work appropriately among group members
- ☐ negotiates solutions to problems
- ☐ displays effective communication skills
- ☐ exhibits basic teamwork skills; e.g., cooperation, appropriate conduct, leadership, commitment, negotiation, sharing

Basic Concepts
- ☐ describes a computer network and solutions provided by computer networking
- ☐ compares the structure and function of:
  - peer-to-peer and server-based networks
  - LANs and WANs

Basic Concepts (continued)
- ☐ explains concepts and technical terms associated with analog and digital signaling
- ☐ illustrates the structure of data packets and frames
- ☐ identifies problems and solutions associated with data collision in a shared media environment
- ☐ describes and compares bus, star, ring, mesh, wireless and hybrid topologies
- ☐ describes and compares main features of Ethernet, token ring, FDDI, LocalTalk and wireless networks with respect to physical topology, methodology and access strategy, media type and speed
- ☐ identifies technical and professional career paths in computer networking and related employment opportunities and training requirements

Application and Utilization
- ☐ creates a timeline of milestones in the history of computer networking
- ☐ creates schematic diagrams for the physical layout of:
  - LANs, MANs and WANs
  - bus, star, ring, mesh, wireless and hybrid topologies
- ☐ converts binary and hexadecimal numbers to decimal numbers
- ☐ selects an appropriate topology and network architecture, and designs a network to address user needs, given a particular set of network requirements
- ☐ uses appropriate technical terms and acronyms

COMMENTS

ASSESSMENT CHECKLIST: Network Media & Devices ELT2320–1

Student Name: ____________________ Teacher: ____________________

Course/Project(s): ____________________ Date: ____________________

CRITERIA	OBSERVATION/ RATING	STANDARD
Management	4 3 2 1 0	2
Teamwork	4 3 2 1 0	2
Basic Concepts	4 3 2 1 0	2
Application and Utilization	4 3 2 1 0	2

STANDARD IS 2 IN EACH APPLICABLE CRITERION UNLESS OTHERWISE STATED

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately.

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately.

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

CRITERIA

The student:

Management

☐ interprets and carries out instructions accurately
☐ plans and uses time effectively in a logical sequence
☐ complies with established network use policies and practices
☐ uses personal initiative to formulate questions and find answers
☐ gathers and responds to feedback regarding approach to task and project status
☐ attempts to solve problems prior to requesting help
☐ demonstrates ethical use of information technologies and sources

Teamwork

☐ cooperates with group members
☐ shares work appropriately among group members
☐ negotiates solutions to problems
☐ displays effective communication skills
☐ exhibits basic teamwork skills; e.g., cooperation, appropriate conduct, leadership, commitment, negotiation, sharing

Basic Concepts

☐ identifies the characteristics and uses of coaxial, twisted pair and fibre-optic cable
☐ identifies the characteristics and uses of common media connectors
☐ defines IEEE standards for Ethernet cabling
☐ defines EIA/TIA categories for UTP cable

Basic Concepts (continued)

☐ describes the media and function of network backbones and segments
☐ describes the features and functionality of
  - basic hardware components (i.e., NIC, hub, repeater, switch, bridge, router, gateway, wireless access point, modem)
  - power fault-tolerance equipment (i.e., surge suppressor, power conditioner, UPS)

☐ identifies basic cabling tools and test equipment
☐ identifies technical and professional career paths in network infrastructure design and installation, and related employment opportunities and training requirements

Application and Utilization

☐ given a practical network scenario:
  - chooses an appropriate cable type and connector to add a new client
  - selects an appropriate hardware component to use or replace an existing device

☐ demonstrates the correct sequence of steps to crimp and test Ethernet cable
☐ demonstrates compliant installation of jacks, outlets, cable and structured cable runs, patch panels and patch cords
☐ demonstrates appropriate use of test equipment in checking for continuity, proper grounding and correct cable termination
☐ creates a proposal for a new or refit cabling project
☐ designs, builds and troubleshoots a small Ethernet network
☐ uses appropriate technical terms and acronyms

COMMENTS

ASSESSMENT CHECKLIST: OSI Model (Open System Interconnection) ELT2330–1

Student Name: ______________________ Teacher: ______________________

Course/Project(s): ______________________ Date: ______________________

CRITERIA	OBSERVATION/ RATING					STANDARD
Management	4	3	2	1	0	2
Teamwork	4	3	2	1	0	2
Basic Concepts	4	3	2	1	0	2
Application and Utilization	4	3	2	1	0	2

STANDARD IS 2 IN EACH APPLICABLE CRITERION UNLESS OTHERWISE STATED

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately.

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately.

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

CRITERIA

The student:

Management
- ☐ interprets and carries out instructions accurately
- ☐ plans and uses time effectively in a logical sequence
- ☐ complies with established network use policies and practices
- ☐ uses personal initiative to formulate questions and find answers
- ☐ gathers and responds to feedback regarding approach to task and project status
- ☐ attempts to solve problems prior to requesting help
- ☐ demonstrates ethical use of information technologies and sources

Teamwork
- ☐ cooperates with group members
- ☐ shares work appropriately among group members
- ☐ negotiates solutions to problems
- ☐ displays effective communication skills
- ☐ exhibits basic teamwork skills; e.g., cooperation, appropriate conduct, leadership, commitment, negotiation, sharing

Basic Concepts
- ☐ explains the purpose of the OSI model:
  - identifies the seven layers and their functions
  - matches components/devices with their layers
  - explains data transfer between layers

Basic Concepts (continued)
- ☐ identifies and describes physical layer components and design structure
- ☐ identifies and describes the function of protocols, hardware components and physical addressing associated with the data link layer
- ☐ identifies and describes the function of protocols, hardware components and logical addressing associated with the network layer
- ☐ explains the function of transport layer protocols in flow control, error handling and name resolution
- ☐ explains the function of protocols and services associated with the session, presentation and application layers
- ☐ identifies technical and professional career opportunities within the context of the OSI model

Application and Utilization
- ☐ analyzes network tasks with respect to the OSI model
- ☐ demonstrates ability to:
  - select appropriate cable, connectors and adapters
  - install and configure a network adapter
  - terminate an Ethernet network
  - test for connectivity
- ☐ given specific user requirements:
  - designs physical layer topology and components for a small Ethernet network
  - creates a plan for cabling based on Ethernet standards
- ☐ uses appropriate technical terms and acronyms

COMMENTS

ASSESSMENT CHECKLIST: Network Protocols

ELT2340–1

Student Name: ____________________ Teacher: ____________________

Course/Project(s): ____________________ Date: ____________________

CRITERIA	OBSERVATION/ RATING	STANDARD
Management	4 3 2 1 0	2
Teamwork	4 3 2 1 0	2
Basic Concepts	4 3 2 1 0	2
Application and Utilization	4 3 2 1 0	2

STANDARD IS 2 IN EACH APPLICABLE CRITERION UNLESS OTHERWISE STATED

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately.

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately.

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

CRITERIA

The student:

Management

☐ interprets and carries out instructions accurately
☐ plans and uses time effectively in a logical sequence
☐ complies with established network use policies and practices
☐ uses personal initiative to formulate questions and find answers
☐ gathers and responds to feedback regarding approach to task and project status
☐ attempts to solve problems prior to requesting help
☐ demonstrates ethical use of information technologies and sources

Teamwork

☐ cooperates with group members
☐ shares work appropriately among group members
☐ negotiates solutions to problems
☐ displays effective communication skills
☐ exhibits basic teamwork skills; e.g., cooperation, appropriate conduct, leadership, commitment, negotiation, sharing

Basic Concepts

☐ describes and compares standard networking protocol suites (i.e., TCP/IP, IPX/SPX, NetBEUI, AppleTalk) in terms of:
- routing
- addressing schemes
- interoperability
- advantages and limitations

Basic Concepts (continued)

☐ gives reasons for the extensive use of the TCP/IP suite
☐ identifies the basic function of protocols that operate within the TCP/IP suite (e.g., TCP, UDP, IP, ARP, FTP, SMTP, POP, IMAP, ICMP, RIP, OSPF, HTTP)
☐ explains IP logical addressing:
- conventions for IP addressing
- characteristics of Class A, B and C addresses
- classful versus classless approaches to subnetting
- static versus dynamic approaches to IP addressing

☐ explains the function of:
- address resolution
- TCP/UDP port numbers

Application and Utilization

☐ analyzes communication tasks by examining their relationship to the OSI model
☐ demonstrates processes for:
- converting between binary and decimal notation
- subnetting Class A, B and C addresses
- determining the subnet mask for a subnetwork

☐ diagrams and interprets an ARP cache
☐ plans and constructs a small peer-to-peer or server-based network:
- applies criteria for planning the network and selecting a network protocol
- installs and configures a workstation for the TCP/IP protocol
- uses appropriate TCP/IP utilities (e.g., SNMP, PING, IPCONFIG, TRACERT, NETSTAT) to validate, troubleshoot and manage a network connection

☐ uses appropriate technical terms and acronyms

COMMENTS

ASSESSMENT CHECKLIST: Local Area Networks

ELT2350–1

Student Name: ______________________ Teacher: ______________________

Course/Project(s): ______________________ Date: ______________________

CRITERIA	OBSERVATION/ RATING	STANDARD
Management	4 3 2 1 0	3
Teamwork	4 3 2 1 0	3
Basic Concepts	4 3 2 1 0	3
Application and Utilization	4 3 2 1 0	3

STANDARD IS 2 IN EACH APPLICABLE CRITERION UNLESS OTHERWISE STATED

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately.

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately.

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

CRITERIA

The student:

Management

☐ interprets and carries out instructions accurately
☐ plans and uses time effectively in a logical sequence
☐ complies with established network use policies and practices
☐ uses personal initiative to formulate questions and find answers
☐ gathers and responds to feedback regarding approach to task and project status
☐ attempts to solve problems prior to requesting help
☐ demonstrates ethical use of information technologies and sources

Teamwork

☐ cooperates with group members
☐ shares work appropriately among group members
☐ negotiates solutions to problems
☐ displays effective communication skills
☐ exhibits basic teamwork skills; e.g., cooperation, appropriate conduct, leadership, commitment, negotiation, sharing

Basic Concepts

☐ identifies the structure and purpose of a LAN
☐ describes and compares ARCNet, LocalTalk, Ethernet, Token Ring, FDDI, ATM and WLAN technologies with respect to:
- topology
- protocols
- media

Basic Concepts (continued)

☐ identifies the physical characteristics and user benefits associated with two or more emerging LAN technologies
☐ describes characteristics and specifications of an Ethernet LAN:
- topology
- cabling and hardware devices
- application of CSMA/CD
- data transmission issues

☐ explains strategies for improving LAN performance
- segmentation and the use of collision domains
- applications of bridge and switch technology

☐ describes the structure, function and benefits of a VLAN
☐ outlines a general strategy for network design

Application and Utilization

☐ applies the 5-4-3 rule for segmentation, and designs a small Ethernet collision domain network
☐ designs and implements a small Ethernet LAN:
- selects appropriate topology and architecture
- recommends a hardware and connectivity solution
- implements the solution by connecting cabling and hardware devices

☐ analyzes and troubleshoots a LAN implementation problem related to:
- topology or architecture
- cabling or network infrastructure
- workstation or other client connections

☐ uses appropriate technical terms and acronyms

COMMENTS

ASSESSMENT CHECKLIST: Network Operating Systems

Student Name: ____________________

Teacher: ____________________

Course/Project(s): ____________________

Date: ____________________

CRITERIA	OBSERVATION/ RATING	STANDARD
Management	4 3 2 1 0	2
Teamwork	4 3 2 1 0	2
Basic Concepts	4 3 2 1 0	2
Application and Utilization	4 3 2 1 0	2

STANDARD IS 3 IN EACH APPLICABLE CRITERION UNLESS OTHERWISE STATED

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately.

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately.

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

CRITERIA

The student:

Management
- ☐ interprets and carries out instructions accurately
- ☐ plans and uses time effectively in a logical sequence
- ☐ complies with established network use policies and practices
- ☐ uses personal initiative to formulate questions and find answers
- ☐ gathers and responds to feedback regarding approach to task and project status
- ☐ attempts to solve problems prior to requesting help
- ☐ demonstrates ethical use of information technologies and sources

Teamwork
- ☐ cooperates with group members
- ☐ shares work appropriately among group members
- ☐ negotiates solutions to problems
- ☐ displays effective communication skills
- ☐ exhibits basic teamwork skills; e.g., cooperation, appropriate conduct, leadership, commitment, negotiation, sharing

Basic Concepts
- ☐ explains differences between peer-to-peer and server-based networks
- ☐ identifies generic functions and administrative tasks common to all network operating systems

Basic Concepts (continued)
- ☐ describes and compares capabilities and functions of network operating systems in common use with respect to:
  - evolution and major features
  - protocols and interoperability
  - client support
  - authentication and security
  - file, print and directory services
  - routing services
- ☐ identifies criteria involved in network planning and implementing a network operating system
- ☐ outlines a general strategy for troubleshooting network problems

Application and Utilization
- ☐ selects network operating system options that are appropriate in specific networking environments
- ☐ analyzes the needs of a small company and recommends an appropriate network operating system solution
- ☐ installs and configures:
  - two or more different network operating systems
  - network clients to interact with and access the resources of each network operating system
- ☐ analyzes and troubleshoots connectivity problems resulting from the installation of network and/or client operating systems
- ☐ uses appropriate technical terms and acronyms

COMMENTS

ASSESSMENT CHECKLIST: Routing Fundamentals

ELT3320–1

Student Name: ______________________

Teacher: ______________________

Course/Project(s): ______________________

Date: ______________________

CRITERIA	OBSERVATION/ RATING	STANDARD
Management	4 3 2 1 0	3
Teamwork	4 3 2 1 0	3
Basic Concepts	4 3 2 1 0	3
Application and Utilization	4 3 2 1 0	3

STANDARD IS 3 IN EACH APPLICABLE CRITERION UNLESS OTHERWISE STATED

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately.

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately.

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

CRITERIA

The student:

Management
- ☐ interprets and carries out instructions accurately
- ☐ plans and uses time effectively in a logical sequence
- ☐ complies with established network use policies and practices
- ☐ uses personal initiative to formulate questions and find answers
- ☐ gathers and responds to feedback regarding approach to task and project status
- ☐ attempts to solve problems prior to requesting help
- ☐ demonstrates ethical use of information technologies and sources

Teamwork
- ☐ cooperates with group members
- ☐ shares work appropriately among group members
- ☐ negotiates solutions to problems
- ☐ displays effective communication skills
- ☐ exhibits basic teamwork skills; e.g., cooperation, appropriate conduct, leadership, commitment, negotiation, sharing

Basic Concepts
- ☐ describes an internetwork and the path determination function of a router
- ☐ compares the function of bridges, switches, routers and gateways

Basic Concepts (continued)
- ☐ describes the operation of a router
- ☐ distinguishes between:
  - static and dynamic routing
  - routable and nonroutable protocols
- ☐ describes and illustrates the function of IP addressing in a routed network
- ☐ explains the concept of address resolution and applications of ARP
- ☐ describes the purpose and function of:
  - distance-vector and link-state routing protocols
  - interior and exterior routing protocols
- ☐ explains the basic architecture and function of common routing protocols (i.e., RIP, OSPF, BGP)
- ☐ explains SNMP and its application in routing

Application and Utilization
- ☐ interprets and uses:
  - router interface and interface modes
  - basic show and test commands
  - startup sequence and setup commands
  - configuration files and modes
- ☐ performs basic router configuration routines:
  - demonstrates router startup and log-in procedures
  - uses command history and editing features
  - configures and verifies IP addresses
  - configures routing protocols and interface
  - configures standard and extended access lists
- ☐ demonstrates ability to troubleshoot a routing loop
- ☐ configures a router for a standard 5-router topology
- ☐ uses appropriate technical terms and acronyms

COMMENTS

ASSESSMENT CHECKLIST: Wide Area Networks

ELT3330–1

Student Name: ____________________ Teacher: ____________________

Course/Project(s): ____________________ Date: ____________________

CRITERIA	OBSERVATION/ RATING	STANDARD
Management	4 3 2 1 0	3
Teamwork	4 3 2 1 0	3
Basic Concepts	4 3 2 1 0	3
Application and Utilization	4 3 2 1 0	3

STANDARD IS 3 IN EACH APPLICABLE CRITERION UNLESS OTHERWISE STATED

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately.

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately.

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

CRITERIA

The student:

Management
- ☐ interprets and carries out instructions accurately
- ☐ plans and uses time effectively in a logical sequence
- ☐ complies with established network use policies and practices
- ☐ uses personal initiative to formulate questions and find answers
- ☐ gathers and responds to feedback regarding approach to task and project status
- ☐ attempts to solve problems prior to requesting help
- ☐ demonstrates ethical use of information technologies and sources

Teamwork
- ☐ cooperates with group members
- ☐ shares work appropriately among group members
- ☐ negotiates solutions to problems
- ☐ displays effective communication skills
- ☐ exhibits basic teamwork skills; e.g., cooperation, appropriate conduct, leadership, commitment, negotiation, sharing

Basic Concepts
- ☐ identifies the structure and function of a WAN
- ☐ describes and gives examples of analog and digital carrier systems and services
- ☐ describes basic processes of modulation, synchronization and multiplexing

Basic Concepts (continued)
- ☐ explains basic circuit-switching and packet-switching processes
- ☐ identifies the functions and services associated with common:
  - circuit-switching technologies (i.e., ISDN, DSL)
  - packet-switching technologies (i.e., x.25, Frame Relay, ATM, SONET/SDH)
- ☐ defines the concept of quality of service (QoS)
- ☐ describes and compares different methods of remote access
- ☐ identifies and explains remote access protocols and services (e.g., SLIP, PPP, PPTP, ICP)
- ☐ identifies internal and external security issues, and the function/benefits of firewalls, proxies and common security protocols (e.g., IPSec, Kerberos, L2TP, SSL)

Application and Utilization
- ☐ compares the QoS offered by selected circuit-switching and packet-switching technologies
- ☐ given a need for remote connectivity in a small office or home office scenario:
  - recommends a remote access connectivity solution
  - selects a remote access protocol/service
  - configures client and server for remote access
  - troubleshoots potential connection problems
- ☐ predicts the impact of implementing a particular security strategy on network functionality
- ☐ analyzes emerging WAN technologies with respect to design, evolution and benefits
- ☐ uses appropriate technical terms and acronyms

COMMENTS

ASSESSMENT CHECKLIST: Internet Processes

ELT3340–1

Student Name: ____________________

Teacher: ____________________

Course/Project(s): ____________________

Date: ____________________

CRITERIA	OBSERVATION/ RATING	STANDARD
Management	4 3 2 1 0	3
Teamwork	4 3 2 1 0	3
Basic Concepts	4 3 2 1 0	3
Application and Utilization	4 3 2 1 0	3

STANDARD IS 3 IN EACH APPLICABLE CRITERION UNLESS OTHERWISE STATED

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately.

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately.

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

CRITERIA

The student:

Management
- ☐ interprets and carries out instructions accurately
- ☐ plans and uses time effectively in a logical sequence
- ☐ complies with established network use policies and practices
- ☐ uses personal initiative to formulate questions and find answers
- ☐ gathers and responds to feedback regarding approach to task and project status
- ☐ attempts to solve problems prior to requesting help
- ☐ demonstrates ethical use of information technologies and sources

Teamwork
- ☐ cooperates with group members
- ☐ shares work appropriately among group members
- ☐ negotiates solutions to problems
- ☐ displays effective communication skills
- ☐ exhibits basic teamwork skills; e.g., cooperation, appropriate conduct, leadership, commitment, negotiation, sharing

Basic Concepts
- ☐ describes the Internet (i.e., origin, architecture and services)
- ☐ explains contributions of emerging technologies in global Internet communication
- ☐ explains the function of IP addressing, subnets and subnet masks in Internet communication
- ☐ identifies problems and solutions associated with IP addressing

Basic Concepts (continued)
- ☐ explains WAN protocols and services (i.e., DHCP, ARP, DNS, ISDN, PPP) with respect to:
  - function
  - architecture
  - configuration
  - benefits
  - possible design issues
- ☐ identifies options for connecting a network to the Internet
- ☐ identifies methods of securing IP traffic between a local network and a service provider
- ☐ identifies technical and professional internetworking career paths and related employment and training opportunities

Application and Utilization
- ☐ demonstrates applications of IP addressing, subnets and subnet masks:
  - subnets an address into a given number of subnetworks
  - determines the subnet mask for a subnetted network
  - optimizes a host/subnet scheme
- ☐ assesses advantages and disadvantages of different options for accessing the Internet
- ☐ plans and implements a strategy for Internet connectivity, given needs within a local network for access to the Internet
- ☐ organizes a portfolio and résumé suitable to present qualifications for an entry-level networking position
- ☐ uses appropriate technical terms and acronyms

COMMENTS

ASSESSMENT CHECKLIST: Network Management

ELT3350–1

Student Name: ____________________ Teacher: ____________________

Course/Project(s): ____________________ Date: ____________________

CRITERIA	OBSERVATION/ RATING	STANDARD
Management	4 3 2 1 0	3
Teamwork	4 3 2 1 0	3
Basic Concepts	4 3 2 1 0	3
Application and Utilization	4 3 2 1 0	3

STANDARD IS 3 IN EACH APPLICABLE CRITERION UNLESS OTHERWISE STATED

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately.

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately.

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

CRITERIA

The student:

Management
☐ interprets and carries out instructions accurately
☐ plans and uses time effectively in a logical sequence
☐ complies with established network use policies and practices
☐ uses personal initiative to formulate questions and find answers
☐ gathers and responds to feedback regarding approach to task and project status
☐ attempts to solve problems prior to requesting help
☐ demonstrates ethical use of information technologies and sources

Teamwork
☐ cooperates with group members
☐ shares work appropriately among group members
☐ negotiates solutions to problems
☐ displays effective communication skills
☐ exhibits basic teamwork skills; e.g., cooperation, appropriate conduct, leadership, commitment, negotiation, sharing

Basic Concepts
☐ gives reasons for protecting data in a LAN
☐ describes the nature, scope and source of potential risks to data in a LAN
☐ identifies major components of a data backup strategy
☐ gives reasons for network security

Basic Concepts (continued)
☐ identifies the characteristics of security risks imposed by viruses, worms, Trojan horses and direct attack
☐ explains strategies for protecting a LAN from internal and external security risks
☐ identifies common sources of network problems
☐ outlines a general strategy for troubleshooting network problems
☐ describes key functions and roles related to network maintenance and support
☐ identifies technical and professional career paths in network administration, maintenance and/or support, and related employment and training opportunities

Application and Utilization
☐ demonstrates appropriate use of:
  - troubleshooting tools (e.g., cable tester, crossover cable, digital voltmeter, protocol analyzer, tone generator)
  - software commands to check configuration or connectivity (e.g., IPCONFIG, PING, TRACERT)
☐ designs a data backup strategy, designs a security plan, and troubleshoots common network problems, given a small office or home office network scenario
☐ develops a plan to maintain and support an operating network
☐ organizes/refines a portfolio and résumé suitable to present qualifications for an entry-level networking position
☐ uses appropriate technical terms and acronyms

COMMENTS

2004 CTS AMENDMENTS
to the
Foods
Guide to Standards and Implementation

Summary of Curriculum Changes

Course revisions:

- FOD2030: Food Decisions & Health
- FOD2060: Milk Products & Eggs
- FOD3010: Food for the Life Cycle

Prerequisite change:

- FOD1010: Food Basics is no longer a prerequisite for FOD2150: Food Safety & Sanitation.

Section B

1. **Remove** page B.5 (1997) and **replace** with new page B.5 (Revised 2004).

Section E

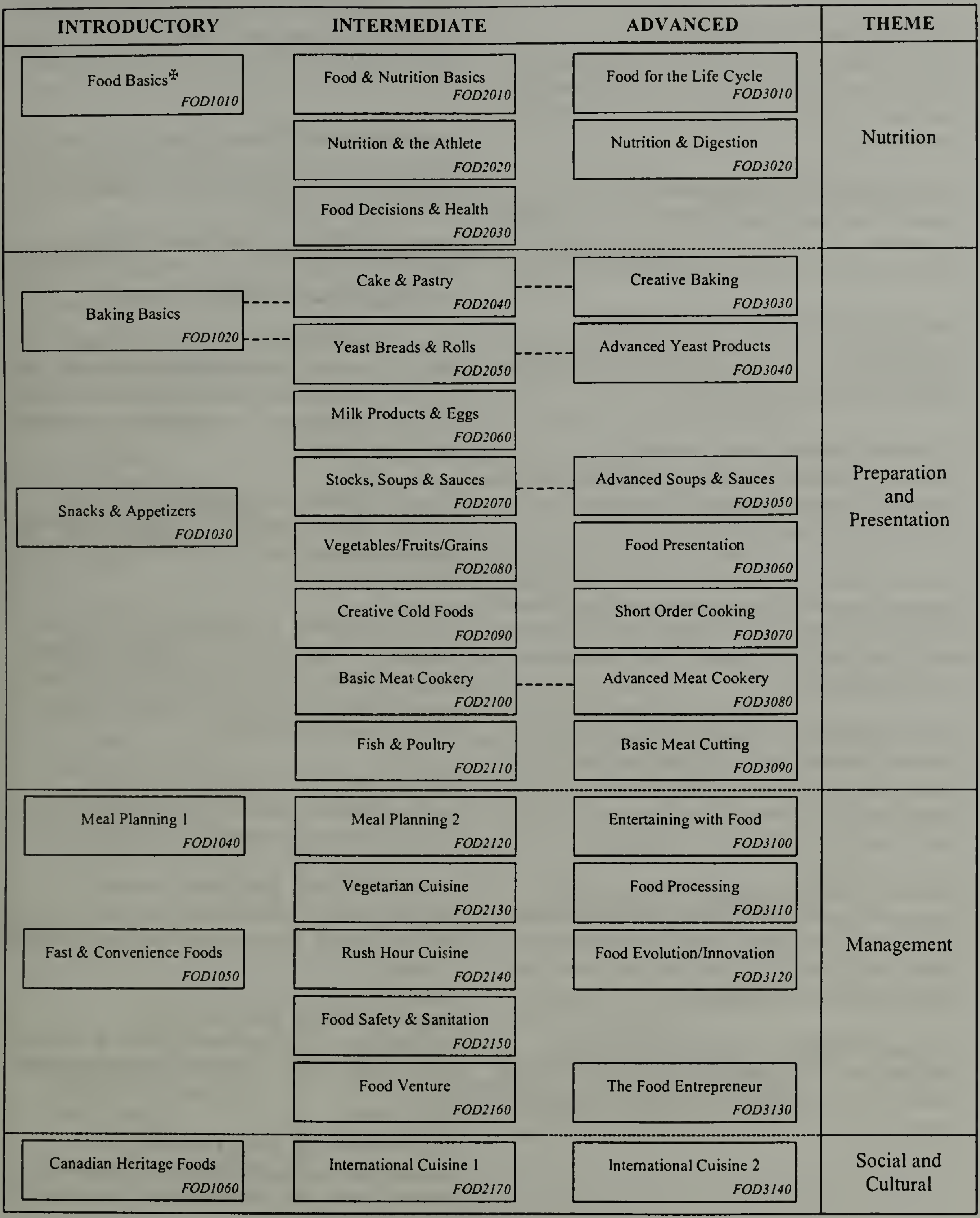
1. **Remove** pages E.15–E.18 (1997) and **replace** with new pages E.15–E.18 (Revised 2004).
2. **Remove** pages E.27–E.31 (1997) and **replace** with new pages E.27–E.31 (Revised 2004).
3. **Remove** page E.73 (1997) and **replace** with new page E.73 (Revised 2004).

Section F

1. **Remove** page F.3 (1997) and **replace** with new page F.3 (Revised 2004).

Section G

1. **Remove** page G.3 (1997) and **replace** with new page G.3 (Revised 2004).
2. **Remove** page G.50 (1997) and **replace** with new page G.50-1 (Revised 2004).
3. **Add** new page G.50-2 (2004).
4. **Remove** page G.74 (1997) and **replace** with new page G.74 (Revised 2004).



INTRODUCTORY	INTERMEDIATE	ADVANCED	THEME
Food Basics✠ *FOD1010*	Food & Nutrition Basics *FOD2010*	Food for the Life Cycle *FOD3010*	Nutrition
	Nutrition & the Athlete *FOD2020*	Nutrition & Digestion *FOD3020*	
	Food Decisions & Health *FOD2030*		
Baking Basics *FOD1020*	Cake & Pastry *FOD2040*	Creative Baking *FOD3030*	Preparation and Presentation
	Yeast Breads & Rolls *FOD2050*	Advanced Yeast Products *FOD3040*	
	Milk Products & Eggs *FOD2060*		
Snacks & Appetizers *FOD1030*	Stocks, Soups & Sauces *FOD2070*	Advanced Soups & Sauces *FOD3050*	
	Vegetables/Fruits/Grains *FOD2080*	Food Presentation *FOD3060*	
	Creative Cold Foods *FOD2090*	Short Order Cooking *FOD3070*	
	Basic Meat Cookery *FOD2100*	Advanced Meat Cookery *FOD3080*	
	Fish & Poultry *FOD2110*	Basic Meat Cutting *FOD3090*	
Meal Planning 1 *FOD1040*	Meal Planning 2 *FOD2120*	Entertaining with Food *FOD3100*	Management
	Vegetarian Cuisine *FOD2130*	Food Processing *FOD3110*	
Fast & Convenience Foods *FOD1050*	Rush Hour Cuisine *FOD2140*	Food Evolution/Innovation *FOD3120*	
	Food Safety & Sanitation *FOD2150*		
	Food Venture *FOD2160*	The Food Entrepreneur *FOD3130*	
Canadian Heritage Foods *FOD1060*	International Cuisine 1 *FOD2170*	International Cuisine 2 *FOD3140*	Social and Cultural

——— Prerequisite ----- Recommended sequence

✠ Prerequisite to most courses in this strand.

COURSE DESCRIPTIONS

Course FOD1010: Food Basics
Students learn to make wise food choices and to understand recipes, equipment, care in handling food, and the importance of safe and efficient work habits.

Course FOD1020: Baking Basics
Students develop an understanding of basic baking ingredients, by combining them in a variety of ways to make cookies, cakes, muffins and biscuits.

Course FOD1030: Snacks & Appetizers
Students apply the importance of snacking to the way we eat, by making nutritious, as well as delicious, snacks and appetizers.

Course FOD1040: Meal Planning 1
Students begin to develop an understanding of eating and meal requirements through the creative planning, preparing and serving of food.

Course FOD1050: Fast & Convenience Foods
Students consider budget, time, quality of food and food alternatives, by making wise choices in the buying, using and preparing of fast foods and convenience foods.

Course FOD1060: Canadian Heritage Foods
Students become aware of how food in Canada today reflects the country's history and origins, by examining food patterns and customs, and by analyzing and preparing ethnic foods.

Course FOD2010: Food & Nutrition Basics
Students learn which foods are crucial to wellness; how such foods affect current performance and future health; and discover how to choose and prepare nutritious, tasty foods.

Course FOD2020: Nutrition & the Athlete
Students learn to prepare foods that help athletes to meet their training and performance nutritional needs.

Course FOD2030: Food Decisions & Health
Students learn how to balance the energy equation, using strategies for food intake analysis, and by preparing appropriate foods that help the body be the best it can.

Course FOD2040: Cake & Pastry
Students expand their knowledge and skills in the production of a variety of cakes and pastries.

Course FOD2050: Yeast Breads & Rolls
Students describe the role of ingredients and use specialized skills in working with yeast.

Course FOD2060: Milk Products & Eggs
Students develop skills with milk products and eggs, and compare the various products available, what they contribute to cooked foods and how they are best used.

Course FOD2070: Stocks, Soups & Sauces
Students combine stocks with various thickening agents to produce basic stocks, hearty soups and foundation sauces.

Course FOD2080: Vegetables/Fruits/Grains
Students learn about the wide range of vegetable, fruit and grain products available, and how to retain their nutritional value and quality through a variety of cooking methods.

Course FOD2090: Creative Cold Foods
Students learn to combine nutrition and creativity in the preparation of salads and sandwiches.

Course FOD2100: Basic Meat Cookery
Students learn to differentiate between cuts of meat, and apply this to tenderizing and cooking methods.

Course FOD2110: Fish & Poultry
Students learn the nutritional value of fish and poultry and how to select, handle and prepare them.

Course FOD2120: Meal Planning 2
Students learn strategies for planning and creating satisfying meals that accommodate busy schedules or strained budgets.

COURSE FOD2030: **FOOD DECISIONS & HEALTH**

Level: Intermediate

Theme: Nutrition

Prerequisite: FOD1010 Food Basics

Description: Students learn strategies to assess the relationships among food intake, physical activity and positive body image.

Parameters: Personal or commercial food preparation facility.

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• describe the relationships among body image, wellness, healthy eating and active living • describe strategies for achieving and maintaining adequate food intake, as per *Canada's Food Guide to Healthy Eating*, and healthy active living, as per *Canada's Physical Activity Guide to Healthy Active Living*	• a project in which the student completes a three day food and activity self-analysis, comparing own actions to suggestions from *Canada's Food Guide to Healthy Eating* and *Canada's Physical Activity Guide to Healthy Active Living*, and in which the student demonstrates understanding of: – realistic goals for appearance, based on genetic predisposition – effect of energy input and output on energy balance equation and metabolism – variables for energy input and energy output – effect of energy balance equation on body weight/composition and realistic goals for weight management – ability to make modifications to achieve recommendations in the guides. *Assessment Tool* *Research: Food Decisions & Health, FOD2030-1 (Revised)* *Standard* *Achieve a minimum performance rating of 2 in applicable areas of assessment*	30
• identify and critique media influences on body image	• an analysis in which the student evaluates at least one media advertisement (e.g., television or magazine advertisement) and considers its impact on body image and self-esteem. *Assessment Tool* *Evaluation of Print Advertisements and Television Commercials, FOD2030-4* *Standard* *All sections have been completed accurately*	10

COURSE FOD2030: FOOD DECISIONS & HEALTH (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• select, prepare and evaluate foods suitable for achieving growth and development during teen years	• a practical laboratory experience in which the student selects, prepares and evaluates a meal consisting of all four food groups from *Canada's Food Guide to Healthy Eating* and analyzes the meal in terms of Dietary Reference Intakes. *Assessment Tool* *Lab Assessment: Intermediate Level, FODLAB-2* *Standard* *Achieve a minimum performance rating of 2 in applicable areas of assessment*	40
	• an analysis of at least three of the products prepared. *Assessment Tool* *Product Analysis, FODPAN* *Standard* *All sections have been completed accurately*	10
• describe the personal or career relevance of the competencies developed within the course	• course reflection in which the student will complete one of the following: – Reflection Log: Intermediate Level, FODREF-2 – Field Trip Assessment, FODFTA – Article or Audio-visual Review, FODAVR – Career Research: Intermediate Level, FODCAR-2. *Standard* *All sections have been completed accurately* *Achieve a minimum performance rating of 2 in applicable areas of assessment for FODCAR-2*	10
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Outcomes	Notes
	The student should:	
Nutrition and Health	• identify psychological and social factors that influence body image	Sensitivity is required when discussing topics related to body image.
	• describe body composition, considering the following factors: – health costs of unhealthy lifestyle choices (e.g., tobacco use for weight management, fad diets, physical inactivity) – body weight versus body composition – methods of measuring body composition – variables in ideal body composition	
	• describe basic body shapes	Gender, activity (contact sports, ballet).
	• predict the impact on the energy balance equation of changes in energy input and energy output: – evaluate factors influencing energy input – analyze the significance of food patterns in altering energy input	
	– differentiate among factors that affect energy output	Age, body size, gender, basic metabolic rate, physical activity.
	– compare energy output required for different types and levels of physical activity – discuss goals for achieving and maintaining healthy body composition	Anaerobic versus aerobic, high intensity versus low intensity.
	• analyze personal energy balance equation	
	• discuss why most diets are ineffective and interfere with natural metabolism and hunger regulation – formulate and apply criteria for evaluation of diets – compare concepts of maintaining a healthy body weight versus dieting to manage weight.	Discuss various perspectives: • Setpoint Theory—explains that our bodies tend to maintain a certain weight, regulated by internal controls • Environmental Point of View—external influences determine body weight • Factors Affecting Metabolism—gender, age and diet

COURSE FOD2030: FOOD DECISIONS & HEALTH (continued)

Concept	Specific Outcomes	Notes
Nutrition and Preparation	*The student should:* • plan, prepare and evaluate a meal to assist with the achievement of: – growth and development during teen years – maintaining a healthy body weight • select, prepare and evaluate the effectiveness of foods in meeting the goals of optimal nutrition, considering: – different cooking methods – varying ingredients • evaluate and compare the macronutrients (contributing the energy) and micronutrients (vitamins and minerals) of a variety of foods.	
Career Exploration/ Portfolio	• describe career options where skills developed in Food Decisions & Health are particularly important.	What competencies have been developed (technical skills, knowledge, attitudes)? How does this relate to the student's beliefs, interests and values? How are these important now? How will they be important in the future?

COURSE FOD2060: MILK PRODUCTS & EGGS

Level: Intermediate

Theme: Preparation and Presentation

Prerequisite: FOD1010 Food Basics

Description: Students develop skills with milk products and eggs, and compare the various products available, what they contribute to cooked foods and how they are best used.

Parameters: Personal or commercial food preparation facility.

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify and compare various milk products and eggs, considering nutritive value, processing and handling • describe the role of eggs in various cooking applications	• **concept test** consisting of questions on: – various forms of milk products and eggs, and their differences – nutritional value of milk products and eggs – processing methods for milk and egg products – care, handling and storage of milk products and eggs – specific food safety concerns with milk products and eggs – rationale for, methods and effect of cooking on milk and eggs – functions of eggs in cooking. *Assessment Tool* Food for Today *Testing Program (Teacher Resource Binder or Testmaker)* Professional Cooking *Instructor's Manual* Food Production Principles *Instructor's Guide* *Standard* *Correctly answer a minimum of 50% of questions*	20
• demonstrate the principles of milk cookery and egg cookery in the preparation and evaluation of a variety of products	• **practical lab experiences** in which the student will produce a minimum of five of the following products, each of which meets or exceeds the standard indicated: – cooked milk product; e.g., milk sauce, cream soup or pudding – cooked cheese dish; e.g., cheesecake, macaroni and cheese	60

COURSE FOD2060: MILK PRODUCTS & EGGS (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:* – egg dishes that demonstrate different functions of eggs: • thickening; e.g., quiche, custard sauce, puddings • leavening; e.g., soufflé, puffy omelette, sponge cake, meringue, Pavlova • emulsifying; e.g., hollandaise sauce, mayonnaise, tartar sauce • coat or glaze; e.g., breads, cookies • binding; e.g., chicken fingers, hamburgers, meatloaf – cooked egg, using moist or dry heat; e.g., hard-cooked, microwaved and poached eggs, basic omelette or frittata. *Assessment Tool* *Lab Assessment: Intermediate Level, FODLAB–2* *Product Standard Scorecard: Milk Products & Eggs, FOD2060–1* *Standard* *Achieve a minimum performance rating of 2 in applicable areas of assessment*	
	• **analysis**: For at least one of these milk products and one of these egg products, the student will complete an analysis of the product. *Assessment Tool* *Product Analysis, FODPAN* *Standard* *All sections have been completed accurately*	10
• describe the personal or career relevance of the competencies developed within the course	• **course reflection** in which the student will complete one of the following: – *Reflection Log: Intermediate Level, FODREF–2* – *Field Trip Assessment, FODFTA* – *Article or Audio-visual Review, FODAVR* – *Career Research: Intermediate Level, FODCAR–2.* *Standard* *All sections have been completed accurately*	10
• demonstrate basic competencies.	• **observations** of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

COURSE FOD2060: MILK PRODUCTS & EGGS (continued)

Concept	Specific Outcomes	Notes
Nutrition	*The student will:* • identify the nutritional importance of milk and milk products, including: – significant nutrients including calcium, complete protein and vitamins A and D – role of calcium from milk in regulating blood pressure, weight and maintaining integrity of bone mass – role of cheese in decreasing dental caries – problems with lactose intolerance • describe the availability of a wide range of milk and egg products with varying nutrients – milk: calcium-enriched, acidophilus, lactose-reduced – milk products: fat-reduced, yogurt with bifidus – eggs: omega-3, free-run/free range, organic, brown, liquid (processed) • describe the composition and nutritional importance of eggs, including: – eggs as a source of complete protein, many vitamins (including vitamin D) and minerals – eggs as a low-calorie, low-fat food • role of protein in building and repairing muscle and tissue.	Osteoporosis. Obesity. High blood pressure. Product development such as “cholesterol-free” eggs.
Nature of Food	• describe the many available milk products including: – key steps in the production and processing of milk products – many forms of milk products • identify principles for milk cookery: – relating milk to principles of protein cookery – accounting for problems that may develop when milk is heated and/or exposed to chemical agents including acids, tannins and salt • describe the process for making cheese	Fortification, homogenization, pasteurization, microfiltration, UHT (ultra high temperature). Fluid, dried, canned, yogurts, ice cream, etc.

COURSE FOD2060: MILK PRODUCTS & EGGS (continued)

Concept	Specific Outcomes	Notes
	The student will:	
Nature of Food (continued)	• identify various types of cheese considering: – types classified by moisture content (soft, semi-soft, hard) – nutritional value – milk used to produce – country of origin – shape – odour – mouth feel – texture – regional and cultural significance – handling and storage of the different types	Cheese types: • unripened/fresh • ripened • ripened semi-soft • semi-soft cured • semi-hard • hard • grating cheeses • process cheeses. Varieties of cheese: • parmesan • gruyere • cheddar • brie • gorgonzola • cream • cottage • oka • port salut • mozzarella • ricotta • blue • camembert
	• identify principles for cheese cookery: – relating cheese to principles of protein cookery – accounting for problems that may develop during cooking	
	• identify principles of egg cookery: – relating eggs to the principles of protein cookery – addressing concerns regarding cooking temperature and prolonged cooking	
	• identify the functions of eggs in cooking, including:	
	– thickening agent	Quiche, custard.
	– leavening agent	Soufflé, angel food cake.
	– emulsifying agent	Hollandaise sauce, mayonnaise.
	– binding and/or coating agent.	

Concept	Specific Outcomes	Notes
	The student will:	
Preparation	• apply knowledge of milk cookery in the preparation and evaluation of a variety of cooked milk dishes • apply the principles of egg cookery in the preparation of eggs and egg dishes, using dry and moist heat cooking methods • apply the principles of cheese cookery in the preparation of foods containing cheese.	Milk sauces, cream soups. Hard-cooked, microwaved, poached eggs. Basic omelette or frittata.
Safety, Sanitation and Equipment	• demonstrate safe hygienic work habits and the correct use of tools and equipment • identify and resolve safety concerns, both food and equipment, significant to Milk Products & Eggs.	Commercial: Double boiler, grater-mechanical, steam-jacketed kettle.
Presentation/Service	• describe the many ways in which cheese and cheese products are used in foods, snacks and menus, highlighting: – proper service of cheese – correct storage of cheese.	
Consumerism	• identify consumer skills for purchasing and consumption of milk products and eggs including understanding of: – grades – appropriate handling and storage – market forms – best before date – nutrition labels.	

COURSE FOD2060: MILK PRODUCTS & EGGS (continued)

Concept	Specific Outcomes	Notes
	The student will:	
Career Exploration/ Portfolio	• describe career options where skills developed in Milk Products & Eggs are particularly important.	What coping skills, attitudes, knowledge have developed? How does this relate to the student's beliefs, interests and values? What competencies have been developed (technical skills, knowledge, attitudes). How are these important now? How will they be important in the future?

COURSE FOD2150: FOOD SAFETY & SANITATION

Level:	Intermediate
Theme:	Management
Prerequisite:	None
Description:	Students learn about food-borne illnesses and the importance of food safety and sanitation training for anyone handling food in personal, as well as commercial, applications. **Note 1**: Because of the theoretical emphasis in this course, consideration might be given to complementing it with a more practical or project course. **Note 2**: Tourism Studies students may achieve the competencies in this course without participating in preparation.
Parameters:	Personal or commercial food preparation facility.

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • describe the relationships among foods, micro-organisms and food-borne illness • describe measures to prevent food contamination and to control the growth of micro-organisms in food • describe the role of regulatory agencies and safety programs, such as the Workplace Hazardous Materials Information System (WHMIS), in maintaining a safe and sanitary environment	*Assessment of student achievement should be based on:* • **concept test** consisting of questions on: – composition of foods and potential for food-borne illness – growth and reproduction of micro-organisms – risks, types, symptoms and prevention of food-borne illness – food safety procedures for receiving, handling and storage of food and equipment – Workplace Hazardous Materials Information System (WHMIS) – regulatory agencies, legislation and inspection procedures. *Assessment Tool* Professional Cooking *Instructor's Manual* National Sanitation Training Program *Instructor's Manual* *Standard* *Score 65% on assigned questions*	40

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• demonstrate the safe handling of food in a manner consistent with section 43 of the *Public Health Act* Food Regulation	• **practical lab experiences** in which the student analyzes and/or demonstrates appropriate food safety knowledge, skills and attitudes in: – handling and storing food – preparing food – cooking food – serving food – maintaining an existing quality control program. *Assessment Tool* *Lab Assessment: Intermediate Level, FODLAB–2* *Safety and Sanitation Checklist, FODSSC* *Standard* *Meet applicable criteria on FODSSC—a minimum of four times*	50
• describe the personal or career relevance of the competencies developed within the course	• **course reflection** in which the student will complete one of the following: – *Reflection Log: Intermediate Level, FODREF–2* – *Field Trip Assessment, FODFTA* – *Article or Audio-visual Review, FODAVR* – *Career Research: Intermediate Level, FODCAR–2.* *Standard* *All sections have been completed accurately*	10
• demonstrate basic competencies.	• **observations** of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

COURSE FOD3010: FOOD FOR THE LIFE CYCLE

Level: Advanced

Theme: Nutrition

Prerequisite: FOD1010 Food Basics

Description: Students describe how life cycle needs change and demonstrate how to meet the challenges of each stage, through preparation techniques and the adapting of foods to satisfy all ages.

Parameters: Personal or commercial food preparation facility.

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • describe the role food plays in the development, enhancement and maintenance of physical, emotional and social wellness throughout the life cycle	*Assessment of student achievement should be based on:* • a research project in which the student researches and plans a two-day menu for an adolescent and a one-day menu for a minimum of one of the following: – infant – toddler – adult – pregnant woman – senior. **Note:** All menus should include age-appropriate foods to achieve optimal nutrition as per recommendations in *Canada's Food Guide to Healthy Eating*. *Assessment Tools:* *Research: Life Cycle Menu Development, FOD3010-1 (Revised)* *DINE Healthy, computerized dietary analysis* *Standard* *Achieve a minimum performance rating of 3 in applicable areas of assessment*	40

COURSE FOD3010: FOOD FOR THE LIFE CYCLE (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• prepare and evaluate foods for the enhancement of wellness throughout the life cycle	• **practical laboratory experiences** in which the student prepares and evaluates foods from four of the following situations: – adapt a family meal to incorporate the preparation of baby food – incorporate a food or food-related activity to contribute to a toddler's intellectual or motor development – enhance calcium intake for a pregnant or breastfeeding woman – accommodate a constraint such as homebound, eating for one or dental problems – meet the needs of an individual with special food needs such as diabetes or allergies, etc. – meet the food needs of an individual with challenges related to mobility, dexterity, vision, etc. *Assessment Tool* *Lab Assessment: Advanced Level, FODLAB–3* *Product Analysis: Special Needs, FODPAS* *Standard* *Achieve a minimum performance rating of 3 in applicable areas of assessment* *All sections have been completed accurately*	40
• identify and describe community nutrition programs	• **research project** in which the student analyzes a community nutrition program. *Assessment Tool* *Research: Community Nutrition Program Analysis, FOD3010–2* *Standard* *Achieve a minimum performance rating of 3 in applicable areas of assessment*	10
• describe the personal or career relevance of the competencies developed within the course, and identify labour market dynamics that may be significant for career choices	• **course reflection** in which the student will complete one of the following: – *Career Research: Advanced Level, FODCAR–3* – *Job Shadow Assessment, FODJS* – *Career Profile Guide, FODCPG* – *Evaluation of Oral Presentation or Demonstration, FODPRES.* *Standard* *All sections have been completed accurately*	10

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ASSESSING STUDENT ACHIEVEMENT IN CTS

The CTS assessment standards assess two basic forms of competency:

- What can a student *do*?
  - **make** a product (e.g., wood bowl, report, garment)
  - **demonstrate** a process
    - strand-related competencies (e.g., keyboarding, hair cutting, sewing techniques, lab procedures)
    - basic competencies (e.g., resource use, safety procedures, teamwork).
- What does a student ***know***?
  - knowledge base needed to demonstrate a competency (link theory and practice).

CTS Defines *Summative* Assessment Standards

The assessment standards and tools defined for the CTS courses, referenced in Sections D, E and F of this Guide, focus on the final (or summative) assessment of student achievement.

Assessment throughout the learning period (formative assessment) will continue to evaluate how students are progressing. Teachers direct and respond to students' efforts to learn—setting and marking tasks and assignments, indicating where improvement is needed, sending out interim reports, congratulating excellence, etc.

Teachers will decide which instructional and assessment strategies to apply during the formative learning period. As formative and summative assessment are closely linked, some teachers may wish to modify the tools included in this section to use during the instructional process. Teachers may also develop their own summative assessment tools as long as the standards are consistent with the minimum expectations outlined by Alberta Learning.

Grading and Reporting Student Achievement

When a student can demonstrate ALL of the exit-level competencies defined for the course (general outcomes), the teacher will designate the course as "successfully completed." The teacher will then use accepted grading practices to determine the percentage grade to be given for the course—a mark not less than 50%.

The time frame a teacher allows a student to develop the exit-level competency is a local decision. NOTE: The Senior High School Handbook specifies that students must have access to 25 hours of instruction for each credit. Students may, however, attain the required competencies in less time and may proceed to other courses.

Teachers are encouraged to consult their colleagues to ensure grading practices are as consistent as possible. High school teachers may wish to refer to "Directions for Reporting Student Achievement in CTS" for information on how to use the CTS course codes to report the credits that students have earned to Alberta Learning. (Copies of this document have been forwarded to superintendents and senior high school principals.)

Components of Assessment Standards in CTS

The following components are included in each course:

- **general outcomes** (in the shaded left column of the course) define the exit-level competencies students are expected to achieve to complete a course. Each general outcome defines and describes critical behaviours that can be measured and observed. The student must meet the standard specified for **ALL** general outcomes within a course to be successful.
- **suggested emphasis** (right column of the course) provides a guideline for the relative significance of each general outcome and can be used to organize for instruction.

PRODUCT STANDARD SCORECARD: NUTRITION & THE ATHLETE

FOD2020–2

Student Name: ______________________________ Date: ______________

Teacher: ______________________ Class: ______________

PRODUCT						
Product Standards	High Carbohydrate	Adequate Protein	Pre-event	During Event	Post Event	On the Road
Cooking Method Appropriate for athletic performance	☐	☐	☐	☐	☐	☐
Ingredients Appropriate for athletic performance	☐	☐	☐	☐	☐	☐
Texture Suitability to product	☐	☐	☐	☐	☐	☐
Flavour Distinct pleasing flavours Complimentary choice of food used Seasoned appropriately	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐
Colour Appropriate for product	☐	☐	☐	☐	☐	☐
Presentation Neatness is observed Displayed and garnished appropriately Proportion is achieved	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐
SCORE						
AT STANDARD	7	7	7	7	7	7
COMMENTS						

RESEARCH: FOOD DECISIONS & HEALTH (Revised) FOD2030–1

Student Name: ______________________ Date: ______________

Teacher: ______________________ Class: ______________

CRITERIA	OBSERVATION/RATING					
Preparation and Planning	4	3	2	1	0	N/A
Information Gathering and Processing	4	3	2	1	0	N/A
Content	4	3	2	1	0	N/A
Collaboration and Teamwork	4	3	2	1	0	N/A
Information Sharing	4	3	2	1	0	N/A

STANDARD IS 2 IN EACH APPLICABLE AREA

Rating Scale (*italics* are optional)

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. Quality, particularly details and finishes, and productivity are consistent and exceed standards. Leads others to contribute team goals. *Analyzes and provides effective client/customer services beyond expectations.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. Quality and productivity are consistent. Works cooperatively and contributes ideas and suggestions that enhance team effort. *Analyzes and provides effective client/customer services.*

2 **meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. Quality and productivity are reasonably consistent. Works cooperatively to achieve team goals.** ***Identifies and provides customer/client services.***

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. Quality and productivity are reasonably consistent. Works cooperatively. *Provides a limited range of customer/client services.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

CRITERIA

The student is able to:

Preparation and Planning
- ☐ set goals and establish steps to achieve them
- ☐ create and adhere to useful timelines
- ☐ use personal initiative to formulate questions and find answers
- ☐ plan and use time effectively

Information Gathering and Processing
- ☐ access a range of relevant in-school/community resources
- ☐ use a range of information-gathering techniques
- ☐ interpret, organize and combine information into a logical sequence
- ☐ record information accurately with appropriate supporting detail and using correct technical terms
- ☐ determine accuracy/currency/reliability of information sources
- ☐ gather and respond to feedback regarding approach to the task
- ☐ analyze three eating disorders in terms of:
  - factors that influence body image
  - healthy versus unhealthy body composition

Content
- ☐ complete a three-day food and activity self-analysis, comparing own actions to suggestions from Canada's Food Guide to Healthy Eating and Canada's Physical Activity Guide to Healthy Active Living, and demonstrate understanding of:
  - realistic goals for appearance, based on genetic predisposition
  - effect of energy input and output on energy balance equation and metabolism
  - variables for energy input and energy output
  - effect of energy balance equation on body weight/composition and realistic goals for weight management
  - ability to make modifications to achieve recommendations in the guides

Collaboration and Teamwork
- ☐ cooperate with group members
- ☐ share work appropriately among group members
- ☐ negotiate solutions to problems

Information Sharing
- ☐ demonstrate effective use of one or more communication media:
  e.g., written, oral, audio-visual
- ☐ communicate ideas in a logical sequence with sufficient supporting detail
- ☐ maintain acceptable grammatical and technical standards
- ☐ cite relevant information sources

COMMENTS

ASSESSMENT TOOL: EVALUATION OF PRINT ADVERTISEMENTS AND TELEVISION COMMERCIALS FOD2030–4

Student Name(s): ________________________________

Standard: **collects and evaluates a minimum of one print advertisement or television commercial, and completes all sections below, as appropriate**

Print Advertisement

Name magazine, newspaper, etc.
Identify target market.
State the objective of the advertisement.
Comments and influences on body image and self-esteem.
Comment on the overall message of the advertisement.

Television Commercial

Type of medium and station: (radio or television)
List time slot and length: (when and where)
Identify target audience.
Explain objective and buying motive.
Identify type of commercial. (testimonial, announcement, etc.)
Comments and influences on body image and self-esteem.
Comment on the message of the presentation.

PRODUCT STANDARD SCORECARD: INTERNATIONAL CUISINE

FOD2170–2

Student Name: ______________________ Date: ______________

Teacher: ______________ Class: ______________

Product							
Product Standards	Technique Cuisine #1	Technique Cuisine #2	Food Group #1	Food Group #2	Common Food #1	Common Food #2	Symbolic Food
Flavour Pleasing flavour Choice of food used Well seasoned	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐
Texture Appropriate to food used Not too soft, mushy or tough	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐
Colour Colour appropriate for product Pleasing, acceptable colour	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐
Presentation Neatness is observed Product is displayed appropriately Proportion is achieved	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐
SCORE							
AT STANDARD	6	6	6	6	6	6	6
COMMENTS							

RESEARCH: LIFE CYCLE MENU DEVELOPMENT (Revised) **FOD3010–1**

Student Name: ______________________ Date: ______________

Teacher: ______________________ Class: ______________

CRITERIA	OBSERVATION/RATING
Preparation and Planning	4 3 2 1 0 N/A
Information Gathering and Processing	4 3 2 1 0 N/A
Content	4 3 2 1 0 N/A
Collaboration and Teamwork	4 3 2 1 0 N/A
Information Sharing	4 3 2 1 0 N/A

STANDARD IS 3 IN EACH APPLICABLE AREA

Rating Scale (*italics* are optional)

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. Quality, particularly details and finishes, and productivity are consistent and exceed standards. Leads others to contribute team goals. *Analyzes and provides effective client/customer services beyond expectations.*

3 **meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. Quality and productivity are consistent. Works cooperatively and contributes ideas and suggestions that enhance team effort.** ***Analyzes and provides effective client/customer services.***

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. Quality and productivity are reasonably consistent. Works cooperatively to achieve team goals. *Identifies and provides customer/client services.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. Quality and productivity are reasonably consistent. Works cooperatively. *Provides a limited range of customer/client services.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

CRITERIA

The student is able to:

Preparation and Planning

☐ set clear goals and establish steps to achieve them
☐ create and adhere to detailed timelines
☐ use personal initiative to formulate questions and find answers
☐ plan and use time effectively, prioritizing tasks on a consistent basis

Information Gathering and Processing

☐ access a range of relevant information sources and recognize when additional information is required
☐ demonstrate resourcefulness in collecting data
☐ interpret, organize and combine information in creative and thoughtful ways
☐ record information accurately with appropriate supporting detail and using correct technical terms
☐ recognize underlying bias/assumptions/values in information sources
☐ assess and refine approach to the task and project status based on feedback and reflection

Content

☐ reflect the following:
  - meet minimum requirements of *Canada's Food Guide to Healthy Eating*
  - age appropriate

Content (continued)

  - meet special nutritional requirements
  - menu varied in colour, texture and flavour

☐ research and plan a two-day menu for an adolescent and a one-day menu for a minimum of one of the following:
  - infant
  - toddler
  - adult
  - pregnant woman
  - senior

Collaboration and Teamwork

☐ cooperate with group members
☐ share work appropriately among group members
☐ negotiate solutions to problems
☐ display effective communication and leadership skills

Information Sharing

☐ demonstrate effective use of a variety of communication media:
e.g., written, oral, audio-visual
☐ communicate thoughts/feelings/ideas clearly to justify or challenge a position
☐ maintain acceptable grammatical and technical standards
☐ give evidence of adequate information gathering by citing relevant information sources

COMMENTS